Outlook for June, July and August For the Front Range and the Rest of Colorado

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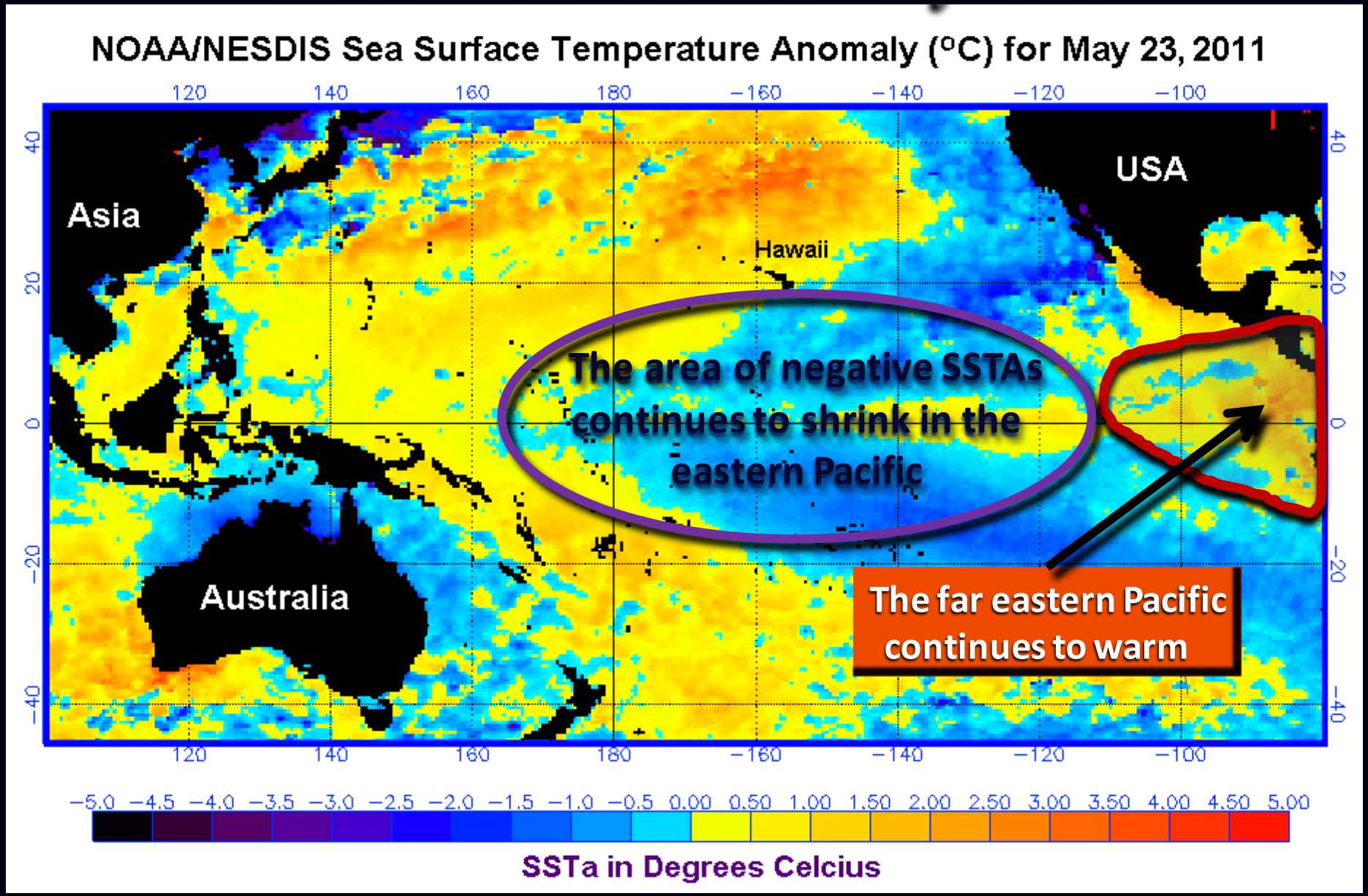
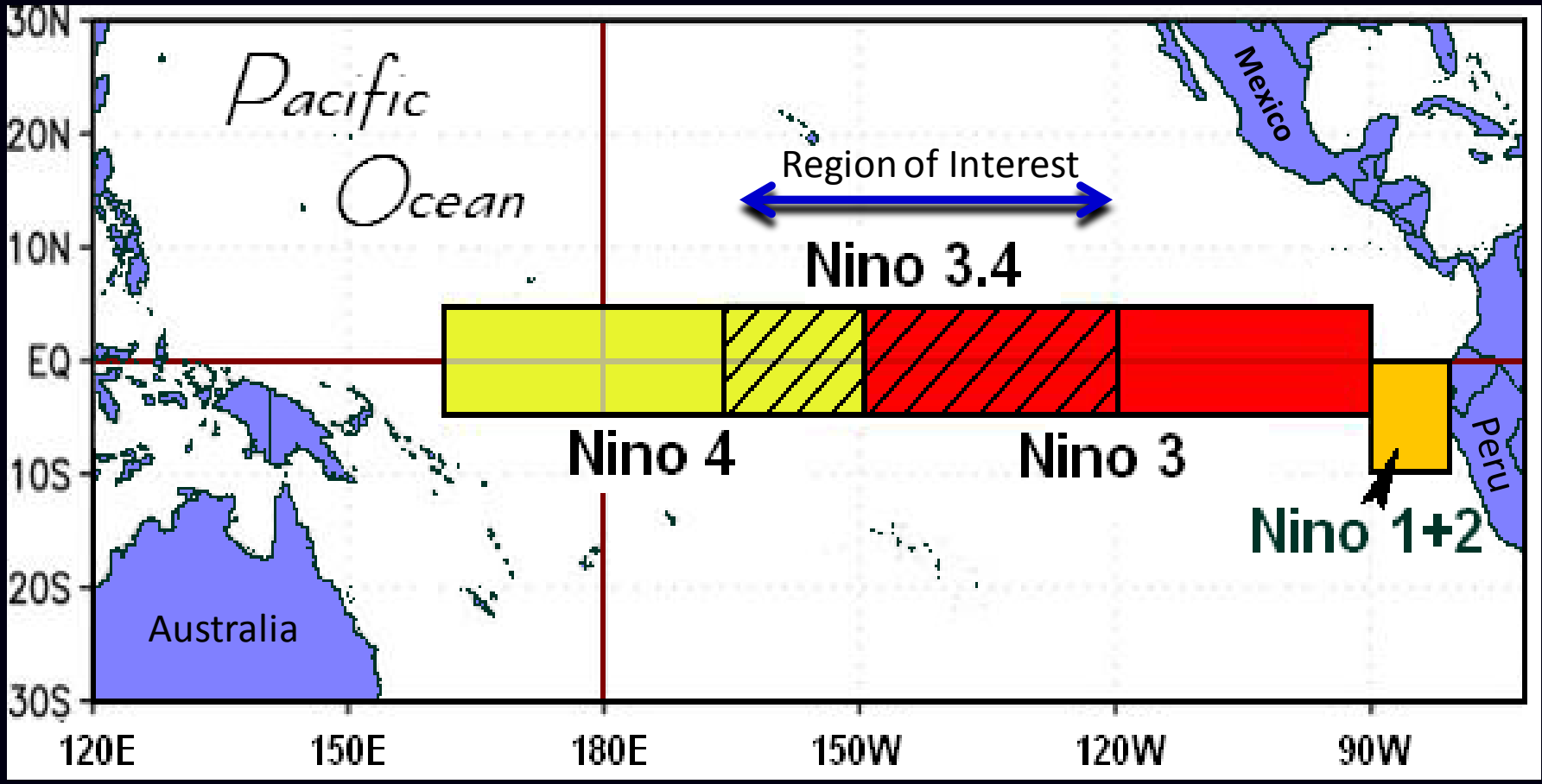
- Update on current La Niña conditions and the outlook for future El Nino/Southern Oscillation (ENSO) events during the next 12 months
- Precipitation, temperature, water-snow equivalents, mountain snowpack and drought conditions across Colorado during the past 90 days
- A look ahead to the kind of weather, including severe weather, that may occur along the Colorado Front Range and across the rest of the state during June, July and August
- The latest wildland fire conditions and three-month outlook for Colorado
- Temperature and precipitation outlooks for Colorado for the period June, July and August of 2011, provided by NOAA's Climate Prediction Center

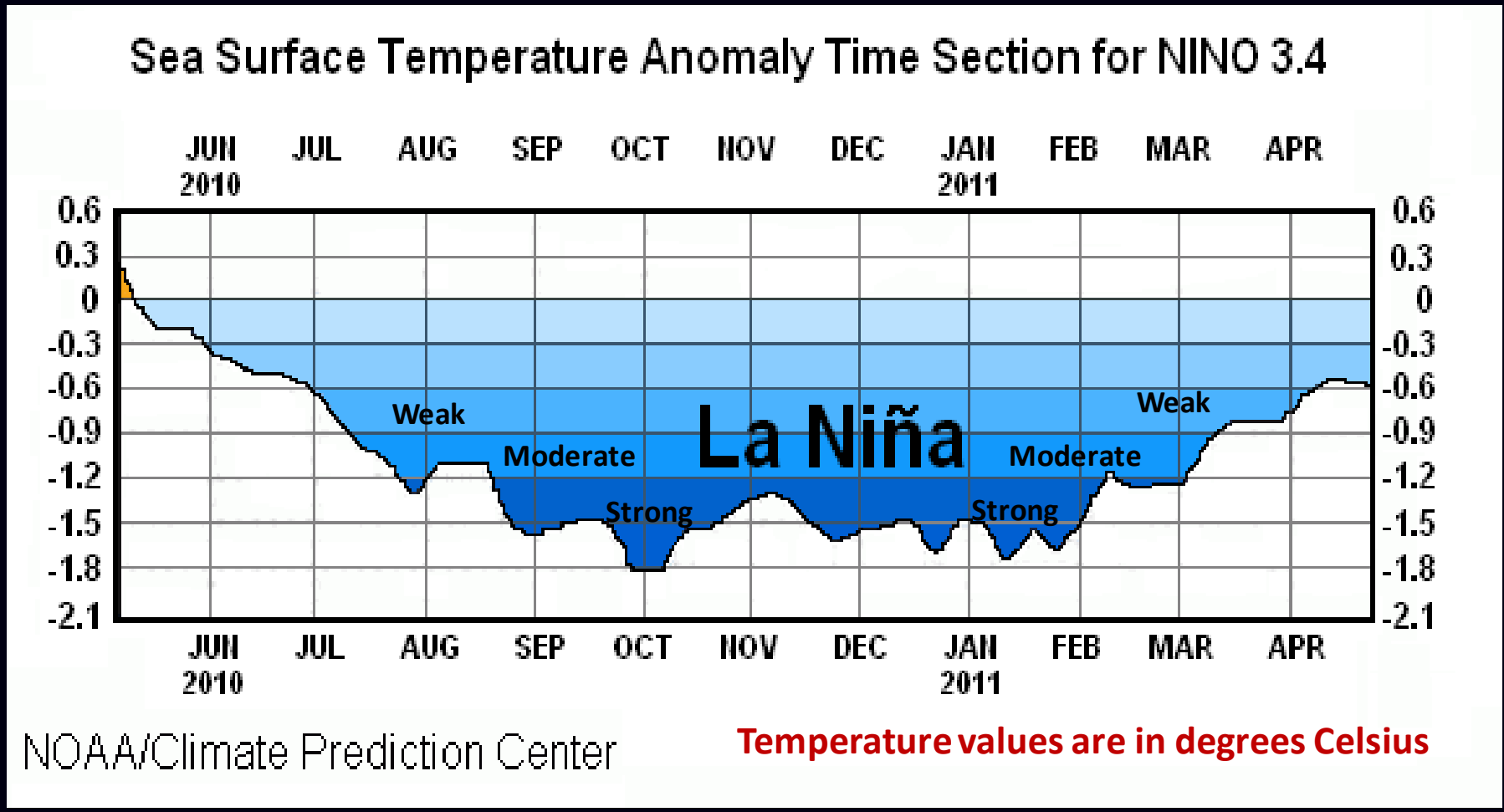
La Niña Is On the Way Out



Niño Regions in the Tropical Pacific Ocean



Nino 3.4 – The principal region in the eastern tropical Pacific used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO.



The sea surface temperature anomaly (SSTa) within NINO 3.4 has continued to warm but at a somewhat slower rate during the past 30 days; still an indication that La Niña continues to weaken.

Oceanic Niño Index (ONI)

- The ONI is based on sea surface temperature (SST) departures from average in the Niño 3.4 region of the Pacific and is a principal measure for monitoring, assessing, and predicting ENSO.
- Defined as the three-month running-mean SST departures in the Niño 3.4 region
- Used to place current events into a historical perspective
- NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a ***positive*** ONI greater than or equal to +0.5 C.

La Niña: characterized by a ***negative*** ONI less than or equal to -0.5 C.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5°C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1.0	-0.8	-0.6	-0.5	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7
2001	-0.6	-0.5	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	0.5	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.1
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1.0	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0	0	0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	-1.3	-1.4	-1.4	-1.4
2011	-1.3	-1.2	-0.9									

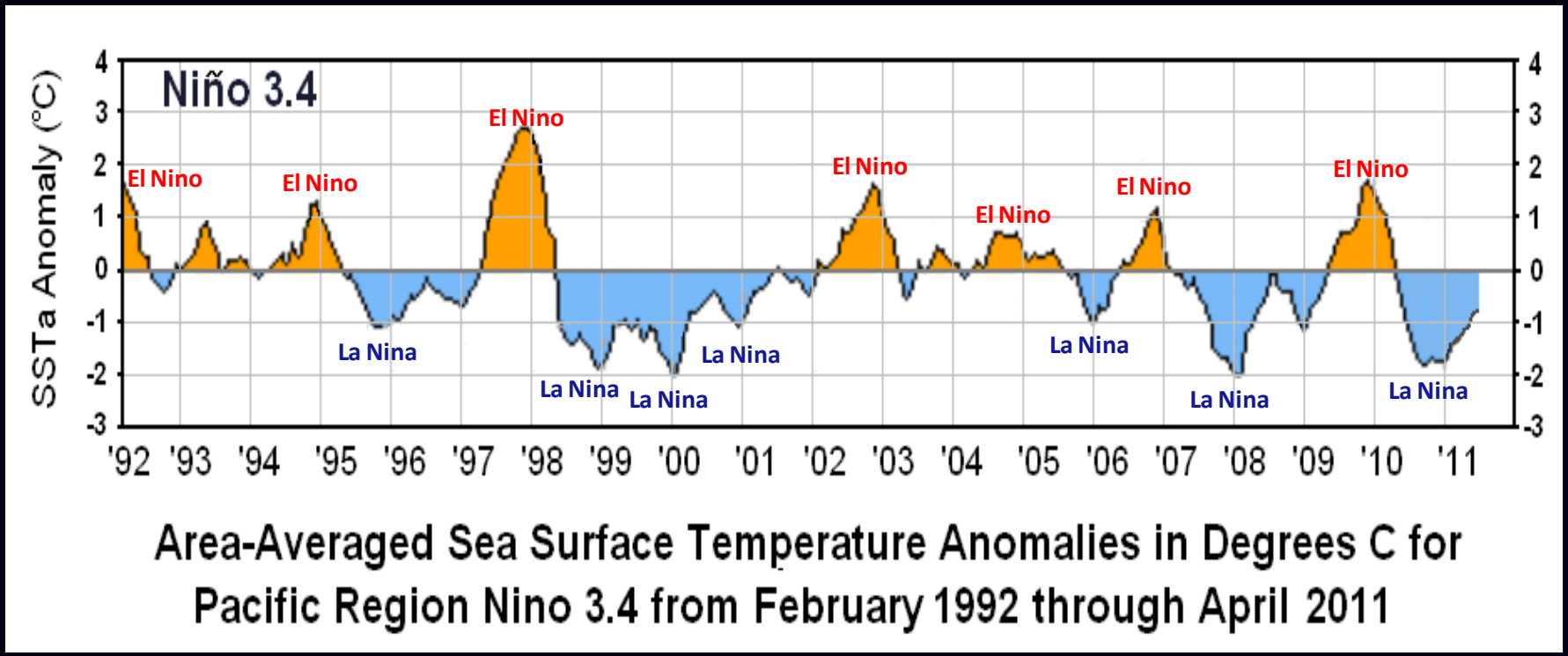
Warm Episodes - El Niños: ONI +0.5 and above (red numbers)

Cold Episodes - La Niñas: ONI of -0.5 and below (blue numbers)

Neutral or non-ENSO Episodes: ONI above -0.5 and below 0.5 (black numbers)

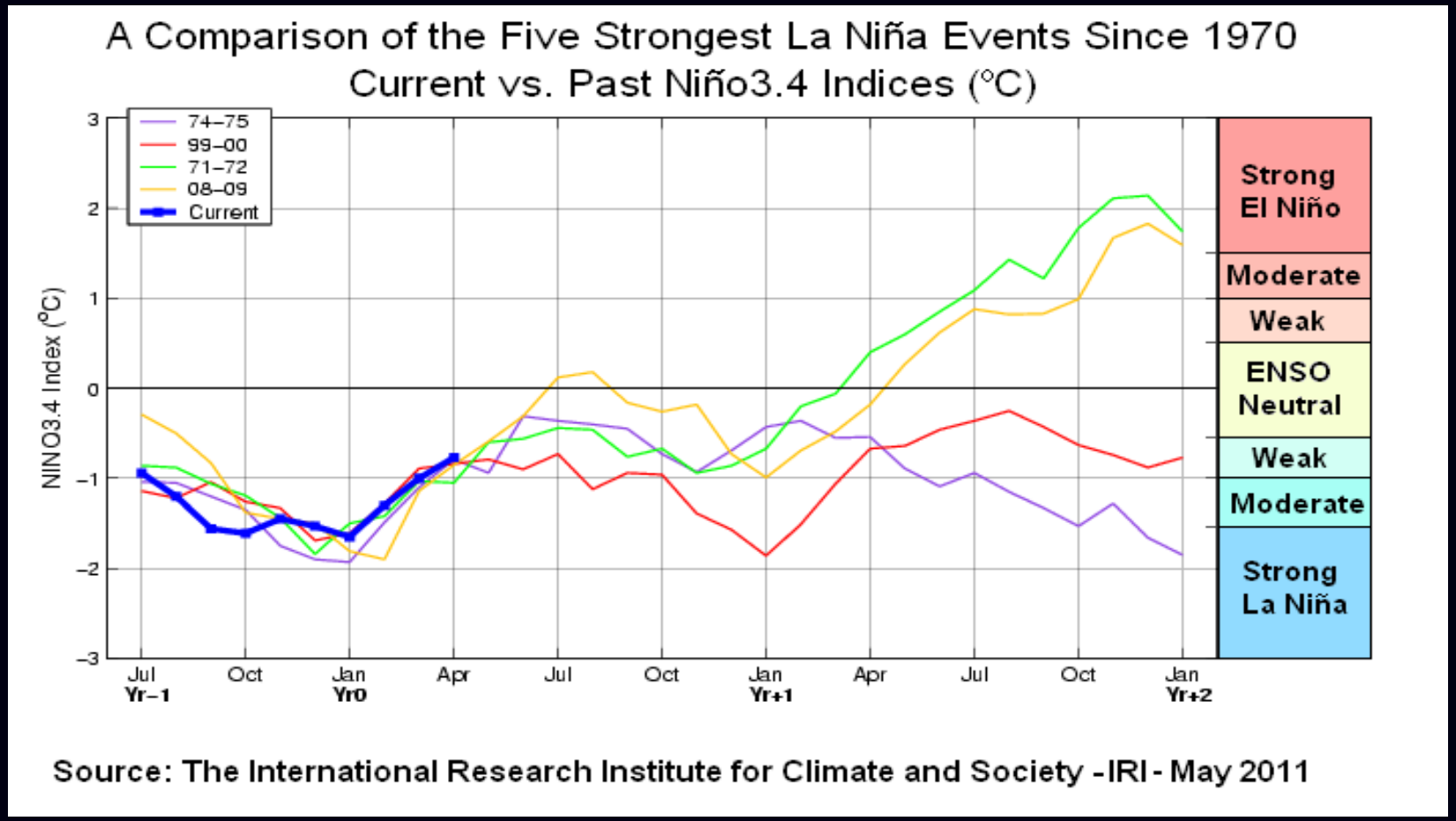
ONI of -0.9 during the climate period February-March-April indicates the presence of a weak La Niña.

NOAA/CPC May 18 2011



Area-Averaged Sea Surface Temperature Anomalies in Degrees C for Pacific Region Nino 3.4 from February 1992 through April 2011

A total of seven El Niño and seven La Niña events of varying magnitudes have occurred since the winter season of 1991-1992. Noteworthy ENSO events include the strong El Niño during the winter seasons of 1997-1998 and 2009-2010, and the strong La Niña events during the winter seasons 1999-2000 and 2010-2011. The strong La Niña during the winter season of 1999-2000 was part of an abnormally long period of La Niña conditions that persisted from the fall of 1998 through the spring of 2001.

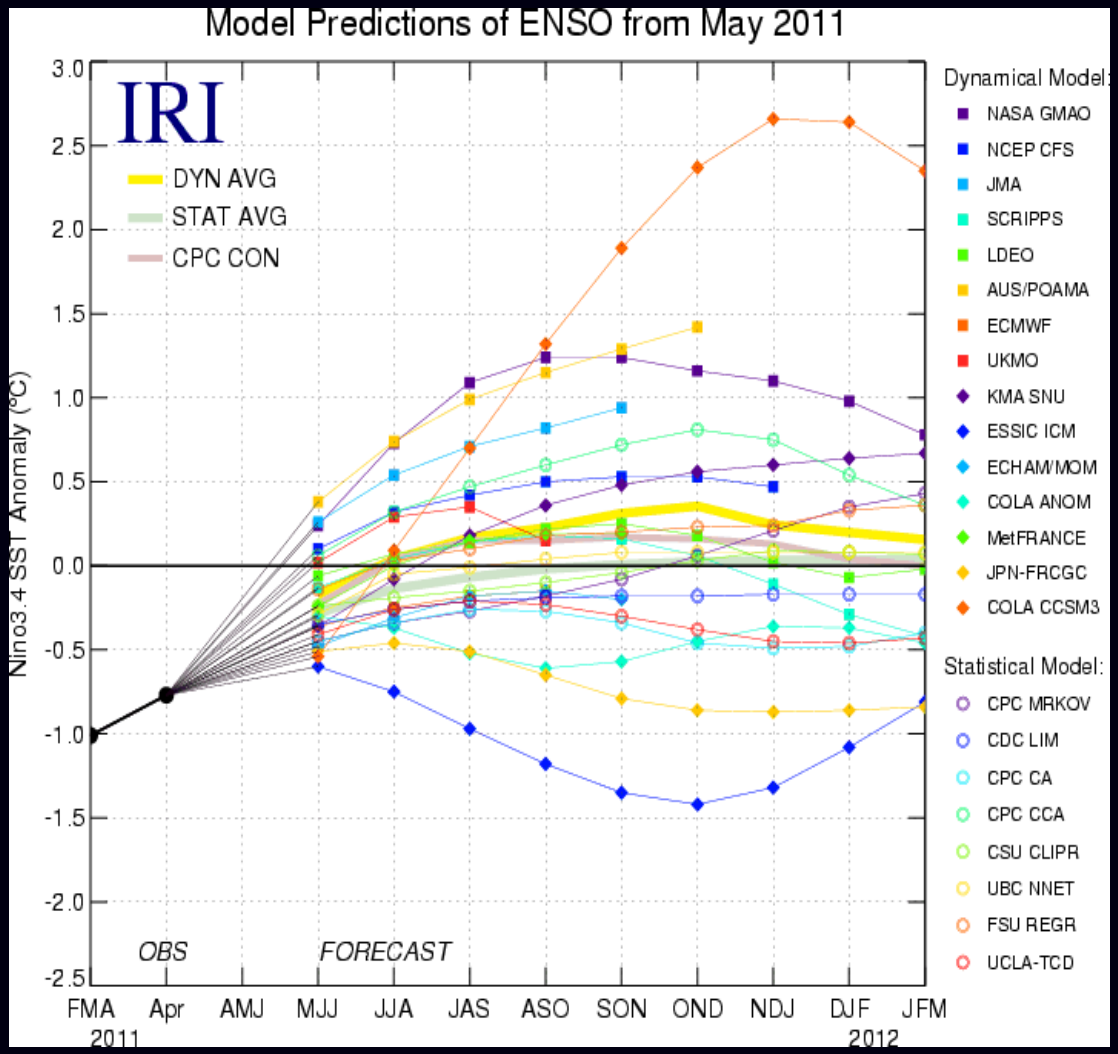


Source: The International Research Institute for Climate and Society - IRI - May 2011

Above is a comparison of the four strongest La Niña events since 1970. Included with these events is the current strong La Niña. All five events attained their greatest magnitude during the months of December, January and February, and all five weakened at a similar rate during the first half of the subsequent spring.

Beyond April, we see the path of the previous four La Niñas diverging. Two of the events remained weak in strength through the following summer, while the other two transitioned to ENSO neutral conditions. Notice the 1999-2000 event returned to a slightly stronger magnitude during the following winter.

Latest Pacific Region Niño 3.4 ENSO Outlook

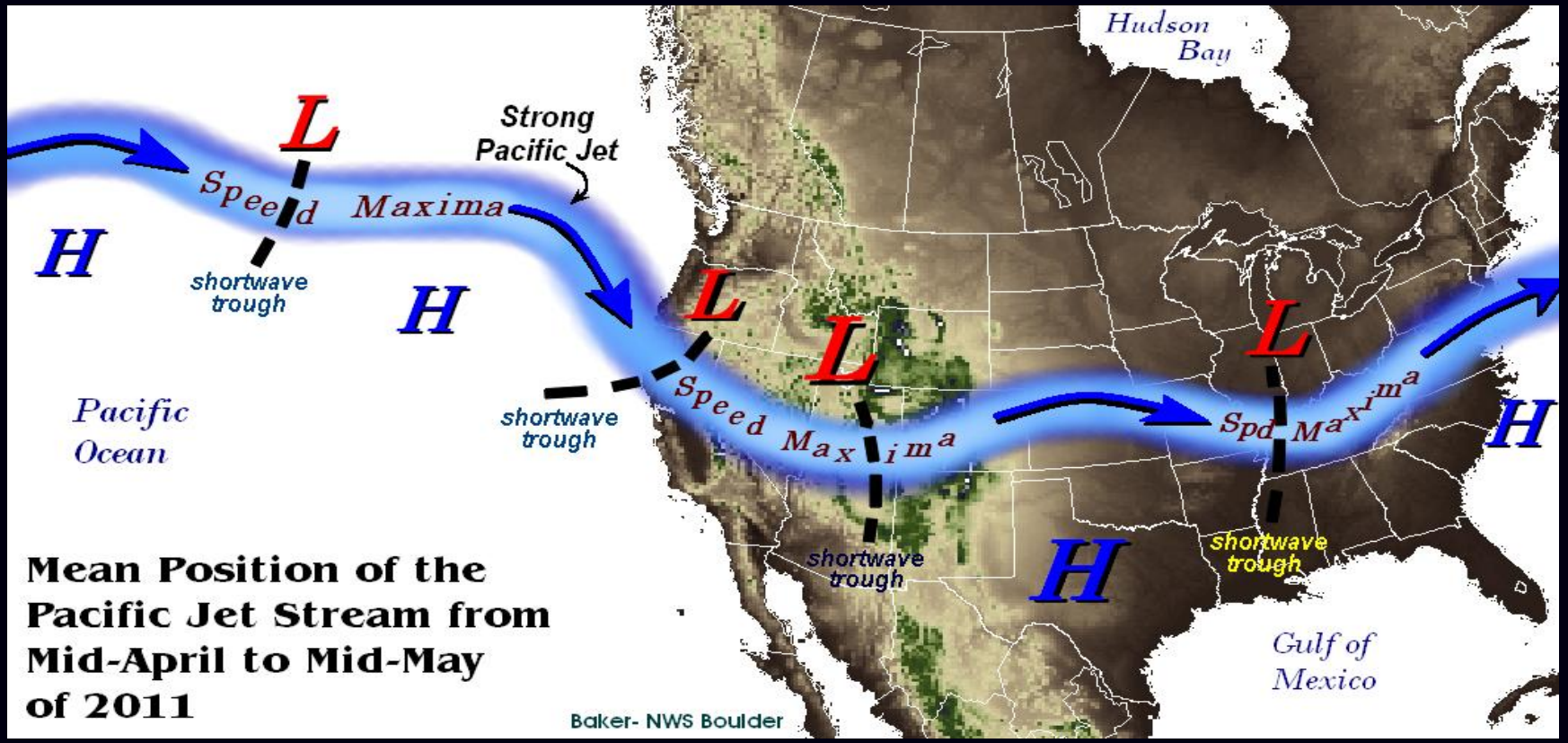


- **The overall majority of 23 dynamical and statistical ENSO models forecast an end to the current La Niña and a move to ENSO neutral (+0.5 C to -0.5 C) conditions by this summer.**

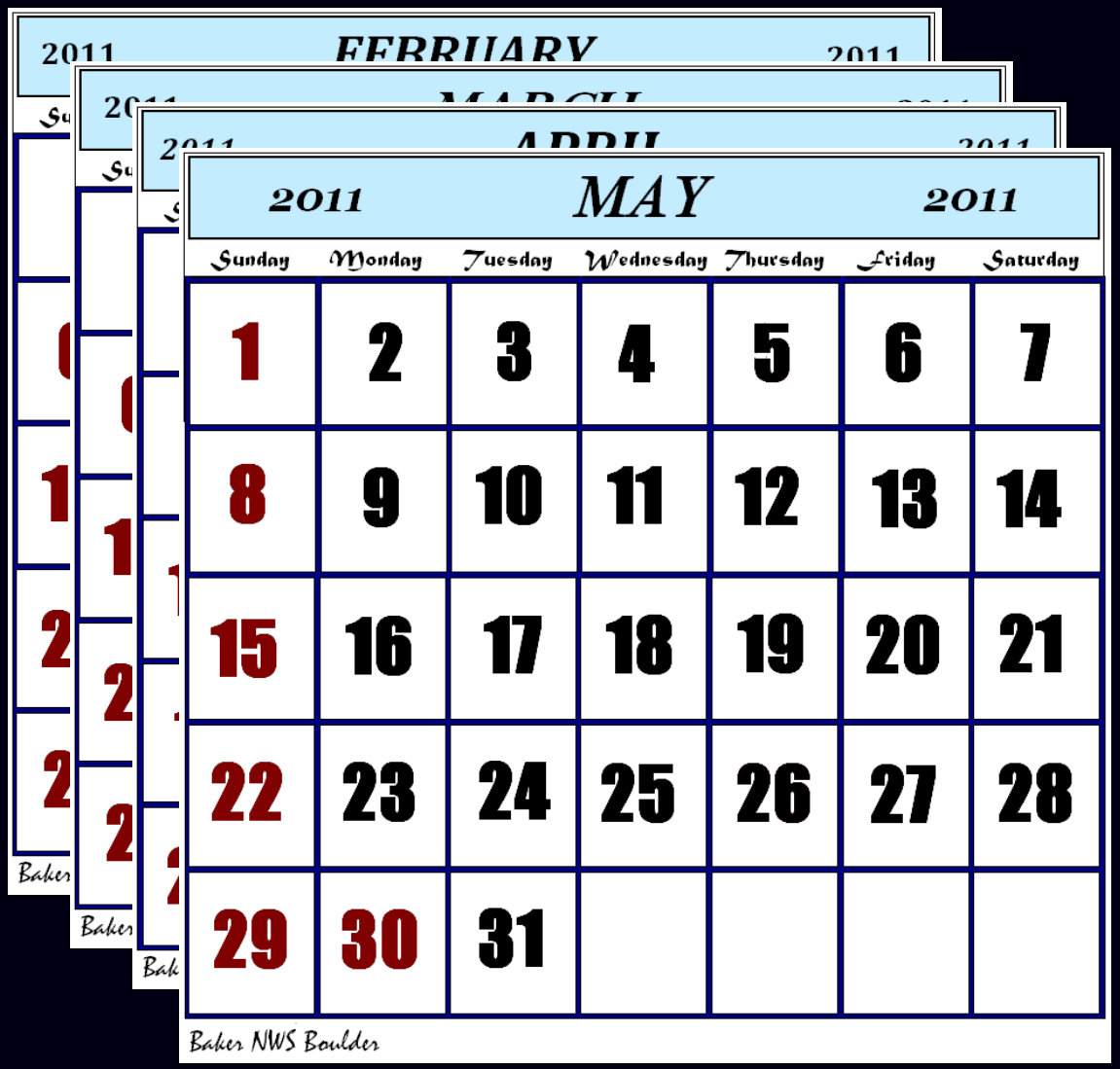
- **The latest model consensus indicates a continuation of ENSO neutral conditions in the eastern tropical Pacific through next autumn, and possibly beyond; although a small number of these models continue to indicate the formation of a weak La Niña or a weak El Niño by late this fall.**

Source: International Research Institute for Climate and Society (IRI) – Updated 5/18/11

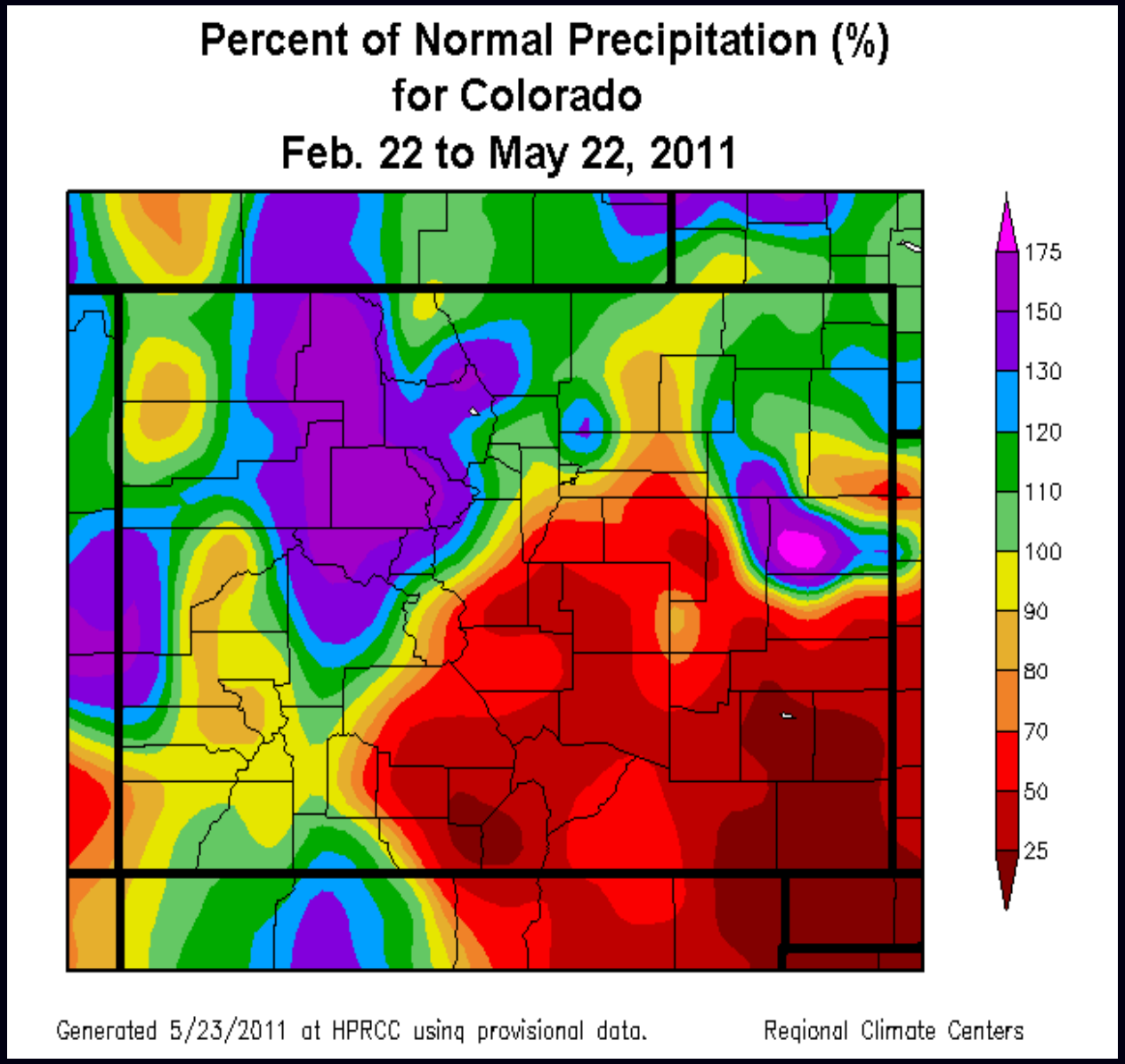
Dominant Pacific Jet Stream Pattern During the Past 30 Days



An abnormally strong Pacific jet stream for April and May remained draped over the center of the continental United States. Unlike earlier in the winter when the jet stream was frequently seen passing over the Pacific Northwest and diving southeastward over the Idaho, southern Wyoming and northern Colorado, this latest trajectory placed it hundreds of miles farther south over northern California , the lower Great Basin and Four Corners region. The jet stream in this position was often associated with a large and persistent trough of low pressure over the Great Basin. This resulted in cooler than normal temperatures for much of the region including most of Colorado, and a southward shift in the distribution of precipitation or storm track. The southern and central mountain ranges of Colorado saw a significant increase in precipitation (rain and snow) due to this southward shift. Areas from the Colorado Front Range eastward also benefited from this change.



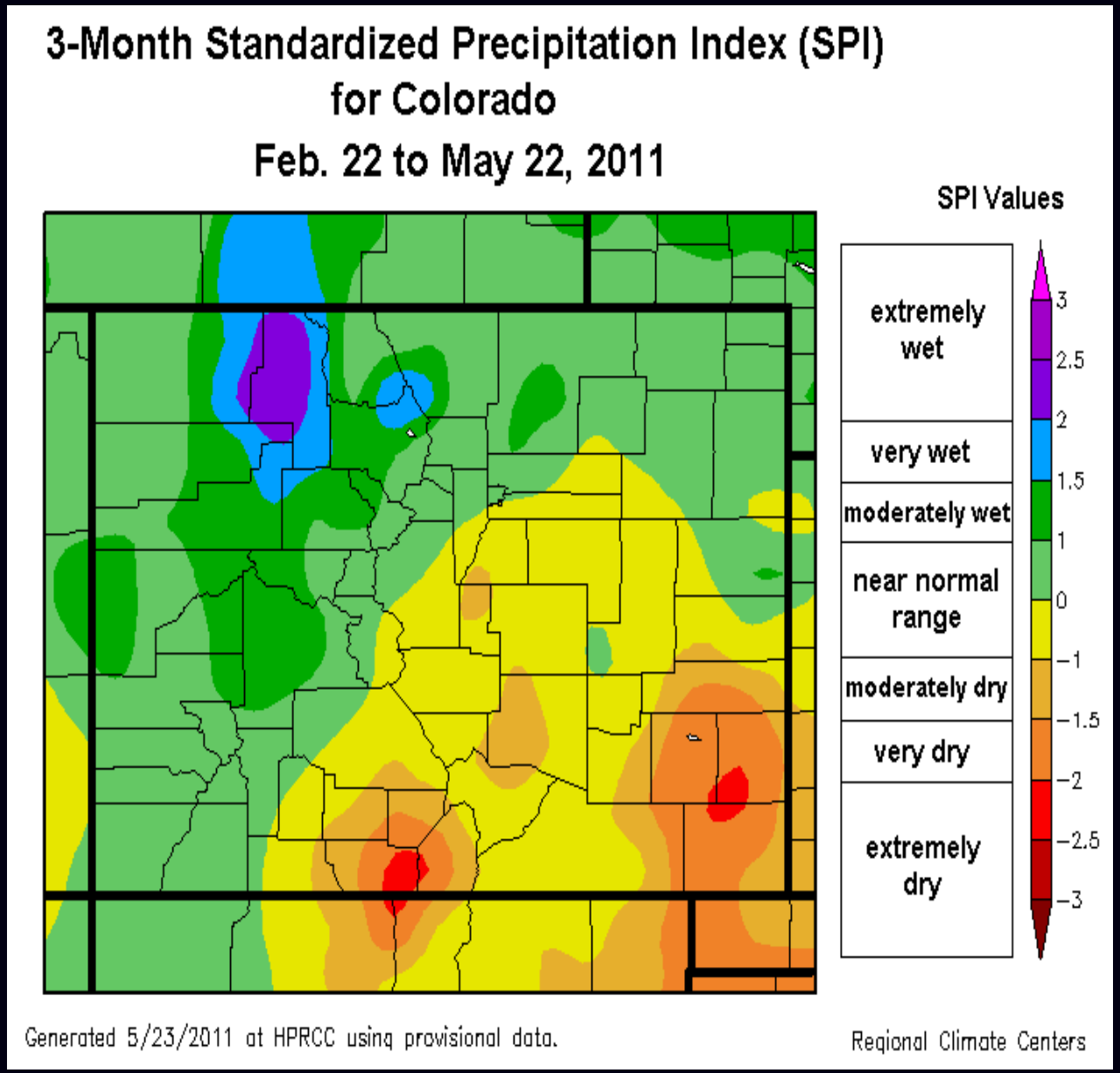
Precipitation, and Drought Conditions Across Colorado During the Past 90 Days



Precipitation for the 90-day period ending May 22nd was as much as 175 percent above normal across parts of northwest and west central Colorado.

Above normal precipitation was also observed along the Colorado/Utah border near Grand Junction and on the east central plains of Colorado.

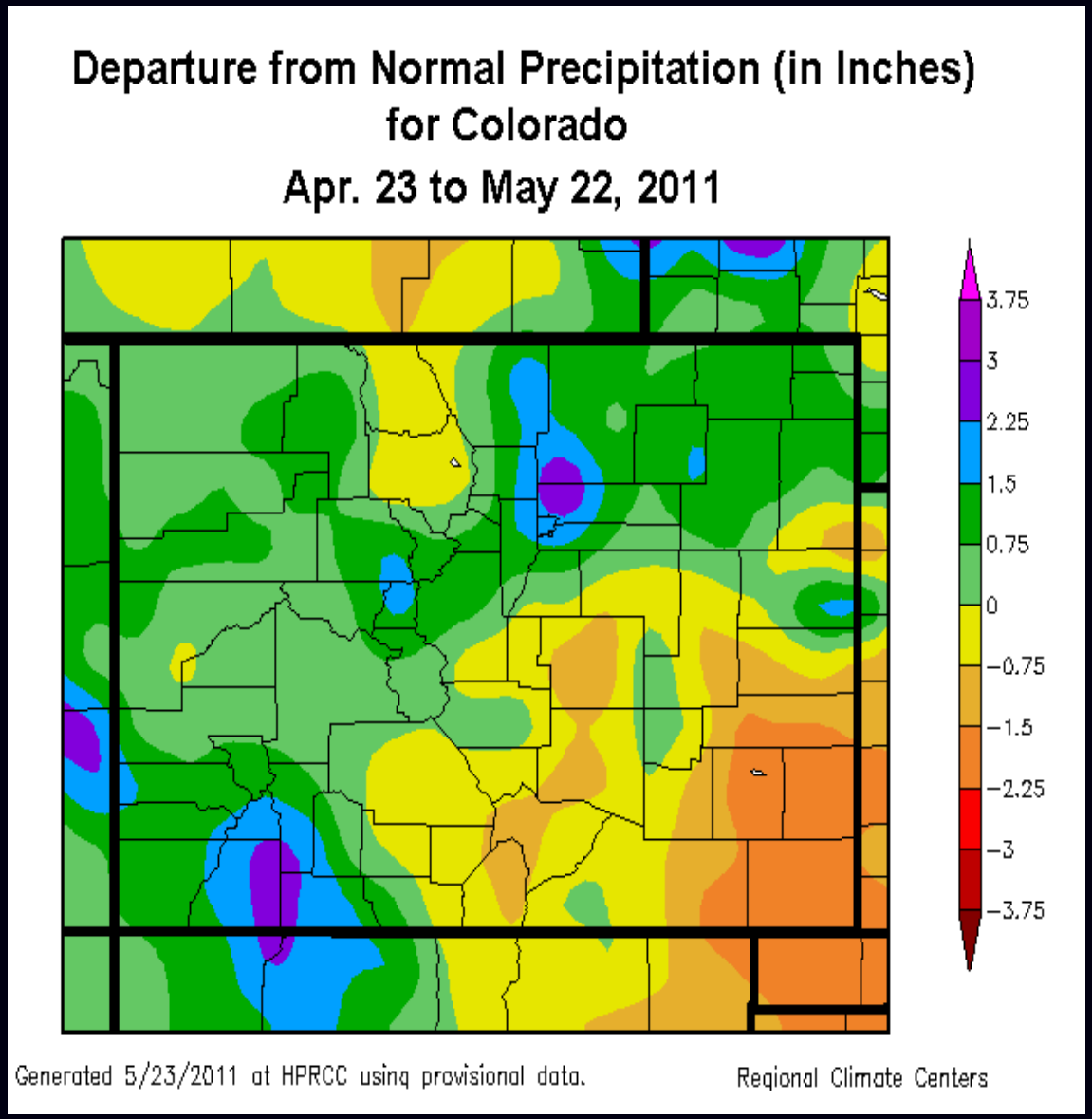
Conversely, the plains of southeast Colorado, the southern mountains including the Wet and Sangre de Cristo Ranges, and the Upper Rio Grande Basin in south central Colorado continued to record much below normal precipitation—a pattern commonly observed during La Niña winters.



During the 90-day period ending May 22nd, the SPI continued to indicate extremely wet conditions across portions of northwest Colorado and moderately wet conditions in west central Colorado and along the Front Range in northeast Colorado. The remainder of the state ranged from near normal to extremely dry on the southeast plains.

The **Standardized Precipitation Index (SPI)** was developed to monitor potential short term agricultural and long-term hydrological drought conditions. The SPI is a probability index that considers only precipitation.

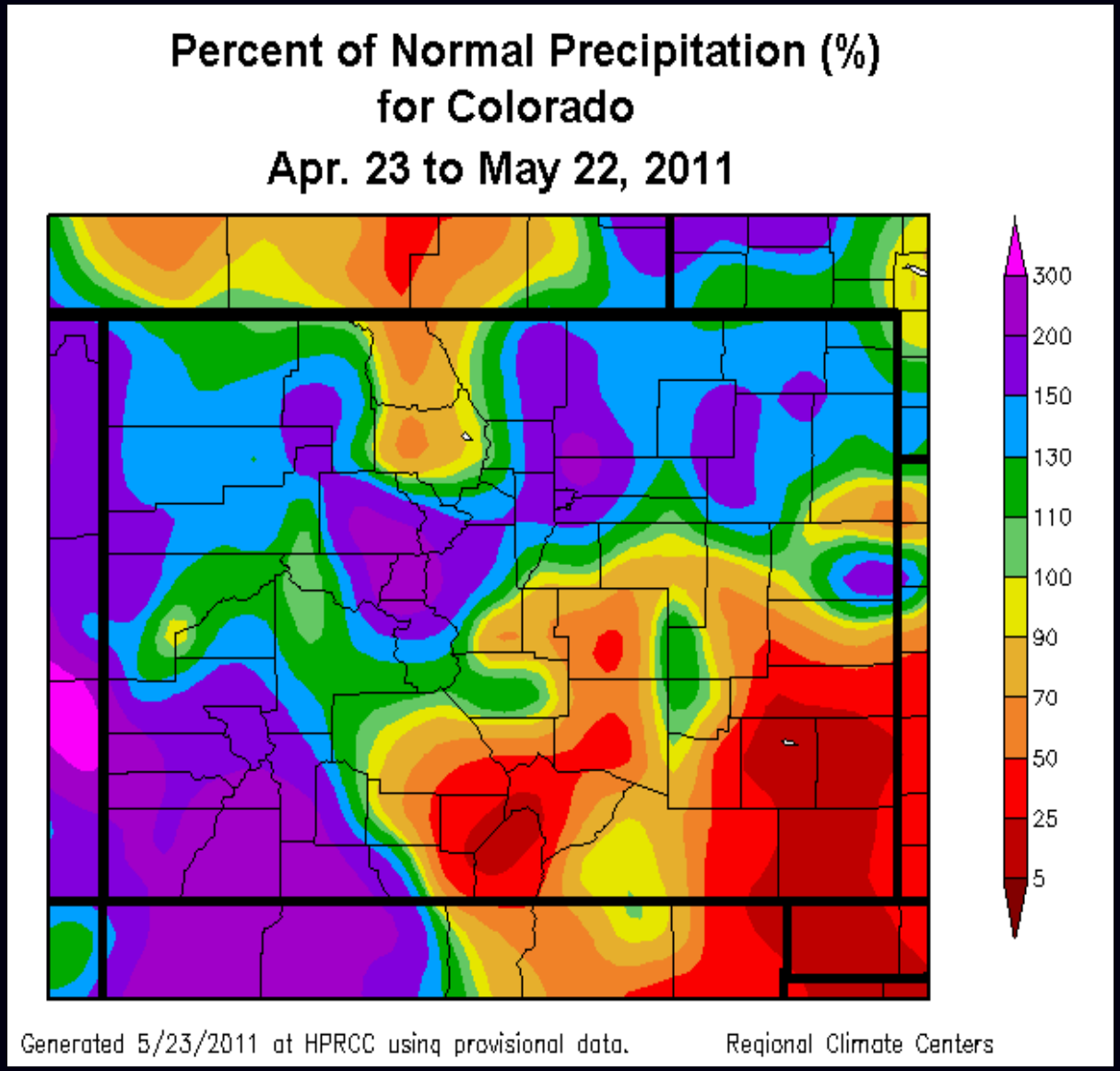
Temperature, Precipitation, and Drought Conditions Across Colorado During the Past 30 days



During the 30-day period ending May 22, 2011, precipitation across western and northeast Colorado generally ranged from one to three inches above normal, with the greatest positive departures recorded in the San Juan Mountains and adjacent valleys in southwest Colorado and along the Front Range in northeast Colorado.

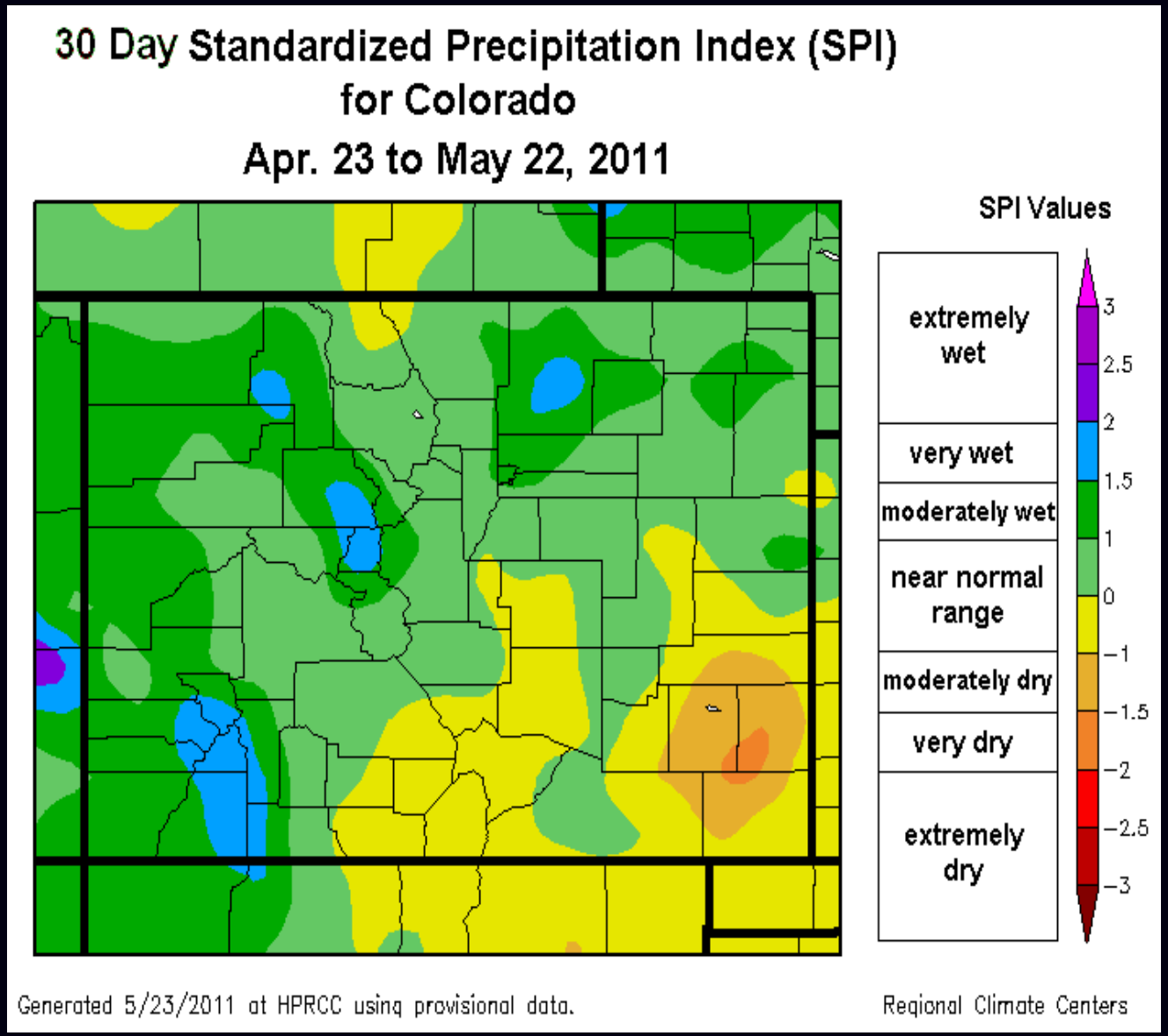
During the same period, most of southeast Colorado, including the San Luis Valley, continued to experience well below normal precipitation, with the least precipitation falling across the far southeast corner of the state.

Unquestionably the most notable change in precipitation during this 30-day period occurred in the Laramie River Basin where below normal precipitation occurred for the first time since last fall.



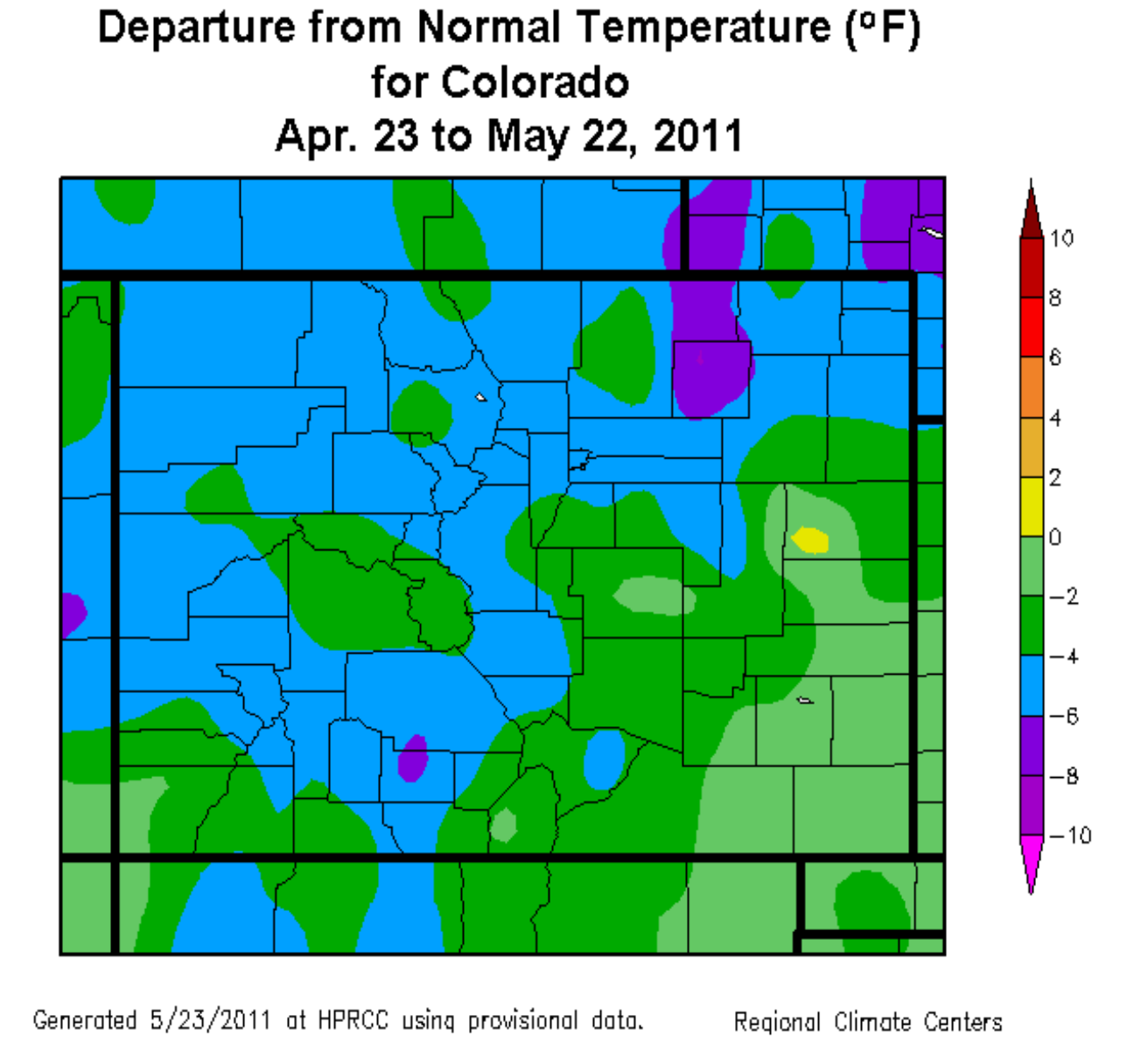
During the 30-day period ending May 22, 2011, precipitation ranged from 150 to nearly 300 percent above normal across most of southwest Colorado, at higher elevations in the central mountains around Vail and Leadville, and along the Front range in northeast Colorado. This pattern of precipitation is a significant change from what was observed for most of the winter when the northwest part of the state saw most of the precipitation.

For the remainder of Colorado, precipitation ranged from 15 to 50% below normal, with the greatest deficits observed in the lower Arkansas River Basin and the Rio Grande River Basin around Alamosa.



As of May 23rd, the SPI indicated very wet conditions across portions of northwest and west central Colorado, and now across southwest Colorado and along the Front Range in the northeast part of the state. The SPI no longer indicated extremely wet conditions across northwest Colorado, a significant change from previous months.

Elsewhere, near normal to drier than normal conditions were indicated as of mid-May.



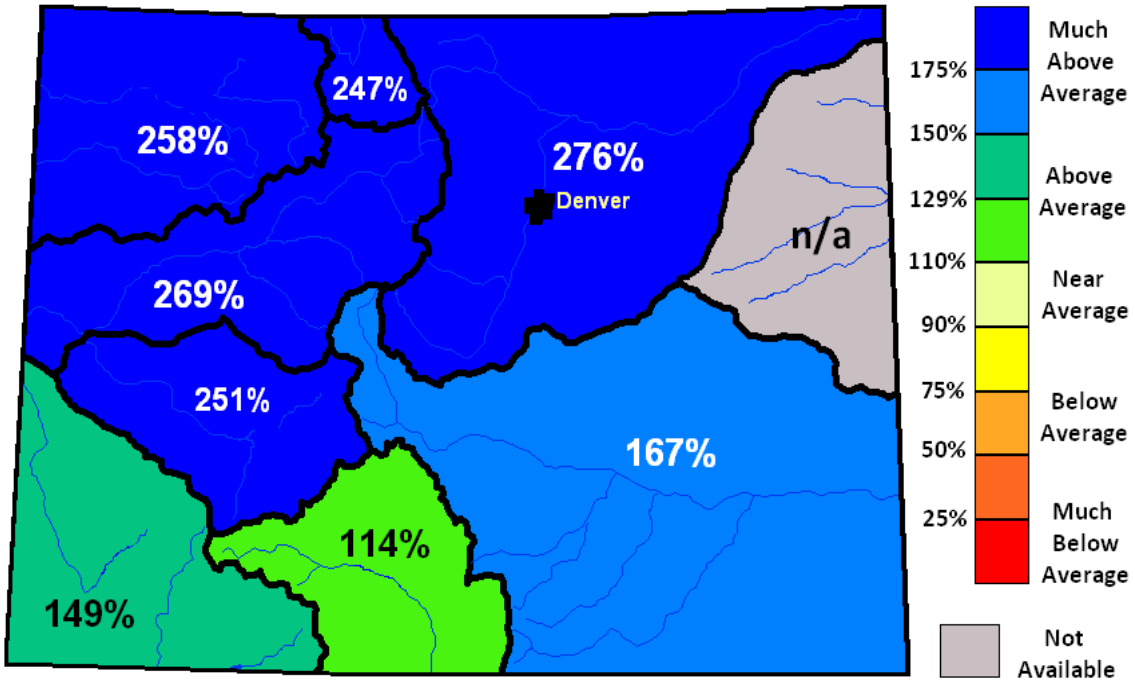
The average monthly temperature across Colorado during the 30-day period ending May 22nd ranged from 4 to 6 degrees (F) below normal across northern and western Colorado, to as much as 6 to 8 degree (F) below average in portions of northeast Colorado.

For the remainder of the state, averages ranged from -3 degrees (F) to near 0 degrees (F).

This period was a marked contrast from the warmer than normal temperatures observed across much of Colorado earlier this spring.


Colorado High Country
Snow-Water Equivalents
and Snow Pack

Snow-Water Equivalent as a Percent of Average (%) for Colorado by River Basin as of May 26, 2011



Basin Wide Percent of Average (%)

WEST SLOPE		EAST SLOPE	
Yampa and White River Basins	258%	Laramie & North Platte Basin	247%
Upper Colorado River Basin	269%	South Platte River Basin	276%
Gunnison River Basin	251%	Arkansas River Basin	167%
San Miguel, Dolores, Animas & San Juan River Basins	149%	Statewide Avg....	239%
Upper Rio Grande Basin	114%		

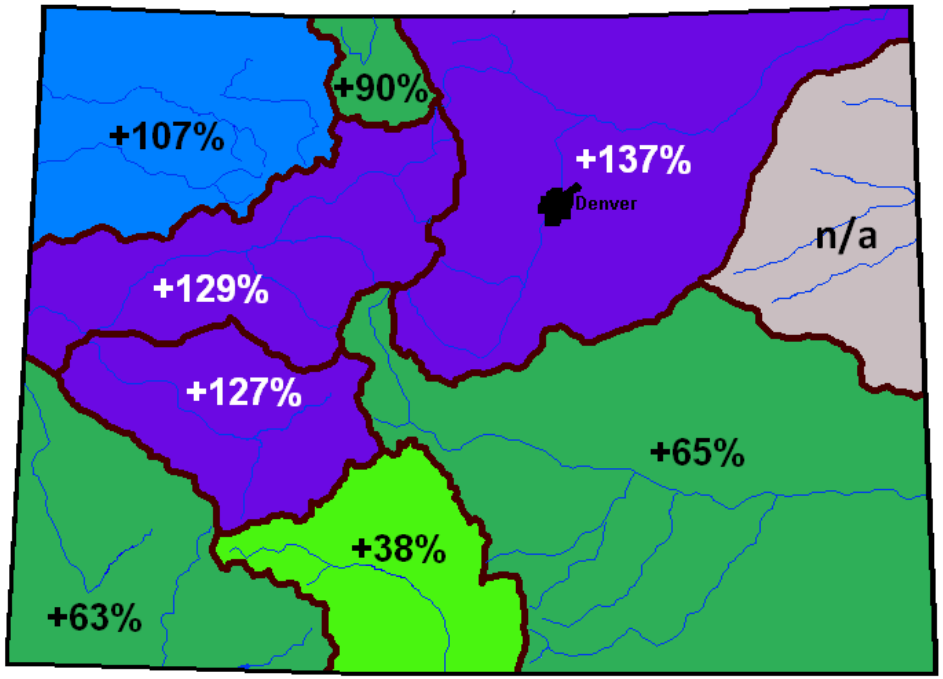
Source: USDA Natural Resources Conservation Service--Water and Climate, Portland, Oregon
provisional data, subject to revision

As of May 26, 2011 snow-water content of the high country snow pack remained much above average in a majority of Colorado's large river basins.

The greatest snow-water equivalents continued to appear in northwest and west central Colorado, although in the past month, the South Platte River Basin joined this group.

The water content of the snow pack across southern Colorado also rose during the past 30 days because of a recent increase in precipitation. Even the exceptionally dry Upper Rio Grande Basin saw a large gain in snow-water equivalents during this period.

Change in Snow-Water Equivalent by Percent Per Colorado River Basin From April 25 to May 26, 2011



Greater than 120%
91 to 120%
61 to 90%
31 to 60%
1 to 30%
No Change
-1 to -30%
-31 to -60%
-61 to -90%
-91 to -120%
Less than -120%
Data Not Available

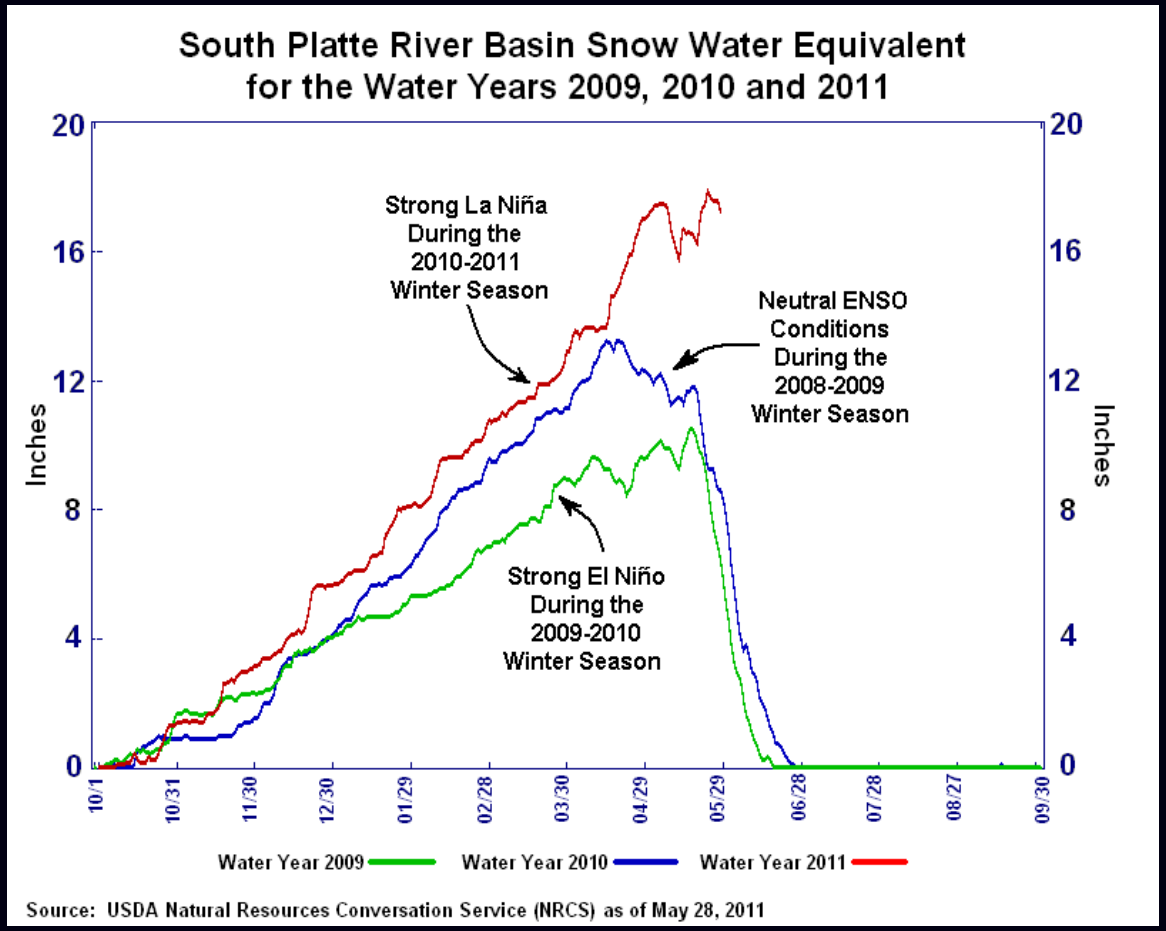
Change as a Percent (%) per Basin

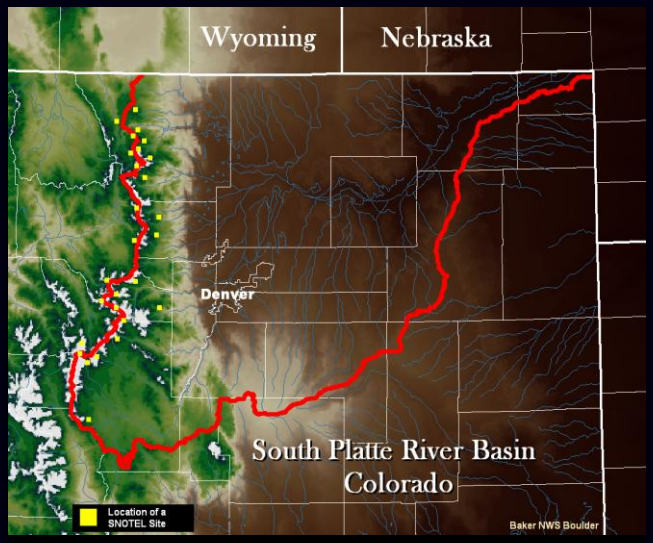
WEST SLOPE		EAST SLOPE	
Yampa and White River Basins	+107%	Laramie & North Platte Basin	+90%
Upper Colorado River Basin	+129%	South Platte River Basin	+137%
Gunnison River Basin	+90%	Arkansas River Basin	+65%
San Miguel, Dolores, Animas & San Juan River Basins	+63%	For the Entire State....	+113%
Upper Rio Grande Basin	+38%		

Source: USDA Natural Resources Conservation Service--Water and Climate, Portland, Oregon
provisional data, subject to revision

The snow-water equivalent of the mountain snowpack in Colorado increased in all major river basins during the period April 25 – May 26 in response to continued snowfall and a delay in the accelerated snowmelt normally observed during this period.

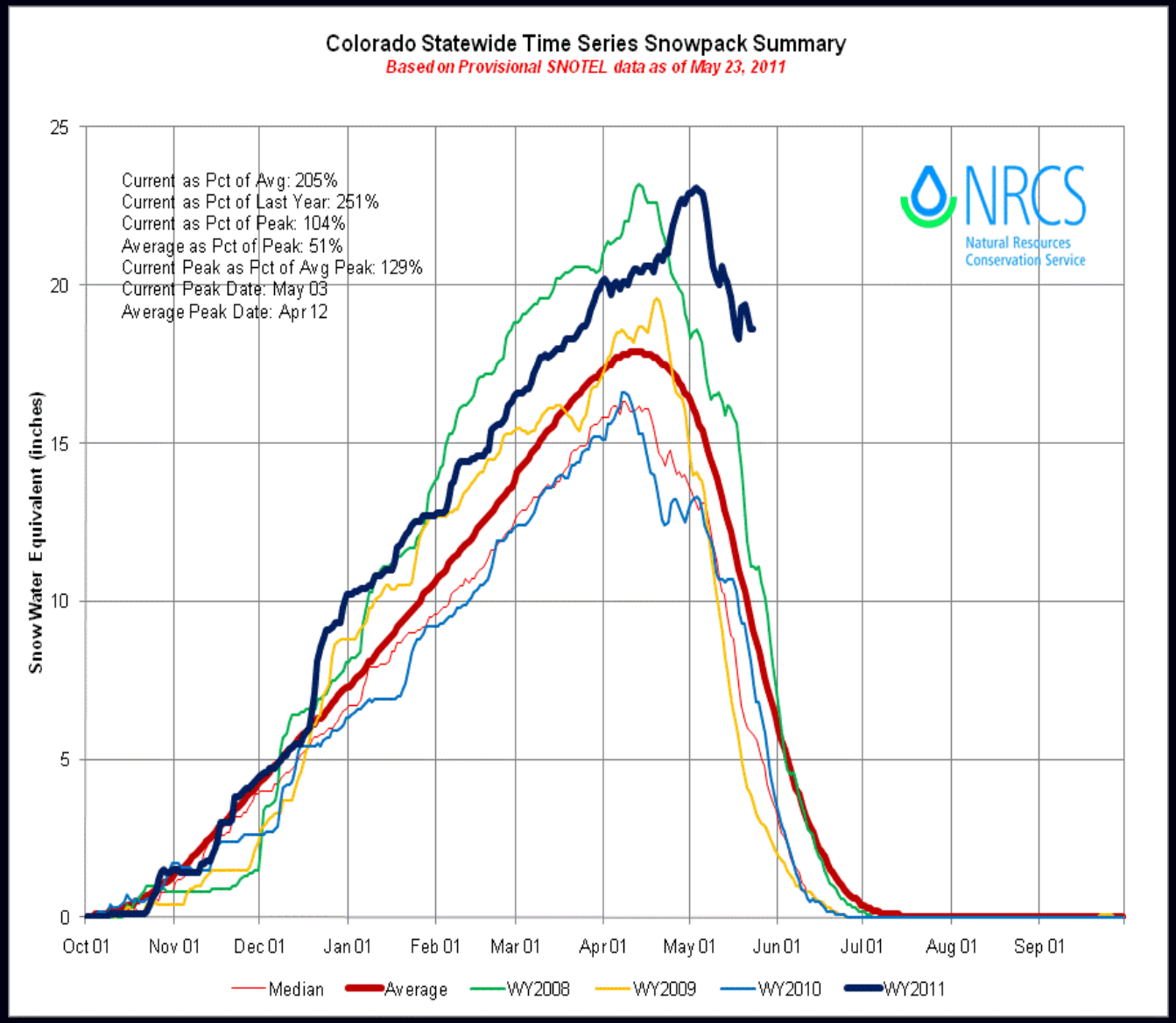
The greatest increase in the snow-water content was observed in the Upper Colorado, Gunnison and South Platte River Basins in the west central and northeast Colorado, respectively. This increase coincided with well above normal precipitation in these areas.





Yellow dots – reporting SNOTEL sites

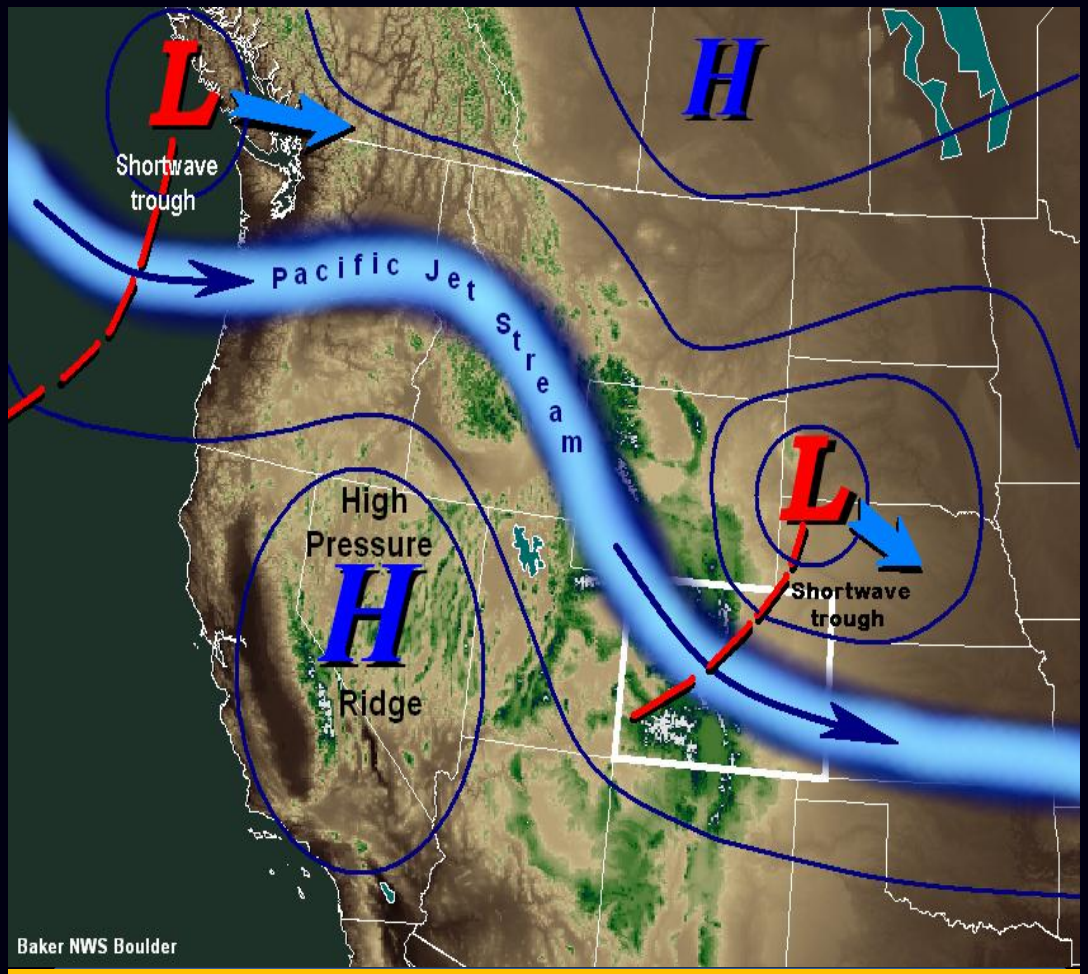
Snow water equivalents recorded at 27 SNOTEL sites in the mountainous terrain of the South Platte River Basin in northern Colorado have risen steadily and remained well above average since last October. Equivalents observed during the current 2011 water year (red line) in the midst of a strong La Niña exceeded values recorded during the 2009 water year (blue line) under neutral ENSO conditions and far surpassed snow-water equivalents recorded during the 2010 water year (green line) during a strong El Niño. Note, a large majority of the reporting SNOTEL sites in the South Platte River Basin are located around timberline exposing them to moisture baring winds from essentially every direction (see map above.)



The current snowpack across Colorado has out-paced those observed during the previous three winter seasons.

As of May 23rd this year, the state's snowpack peaked shortly after May 1st, approximately three week after the average peak date of April 12th.

In the Coming Weeks – "Beware of Northwest Flow"



Thunderstorms produced by disturbances embedded within this northwest flow are likely to produce large hail (sometimes to great depths), damaging outflow winds and even tornadoes.

At the end of previous moderate to strong La Niñas , the Pacific jet stream would weaken and shift north of the U.S./ Canadian border often by no later than early June.

Once this occurred, temperatures would soar across the western continental United States (CONUS) beneath a strong and often stationary ridge of high pressure. As this ridge strengthens and expands northward, the prevailing flow aloft over Colorado became northwesterly in direction often for days, if not weeks at a time. Weather disturbances or "shortwave troughs" carried along by this swift, strongly sheared river of air was often responsible for producing severe weather across northeast Colorado during late May and June. The severe weather threat along the Front Range in northern Colorado normally peaks during the first three weeks of June.

The Weakening La Niña May Continue To Influence Colorado's Weather During June and Possibly July.

Flooding Caused by the Rapid Melt of a Record Mountain Snowpack

An Increased Likelihood of Hail Storms on the Plains

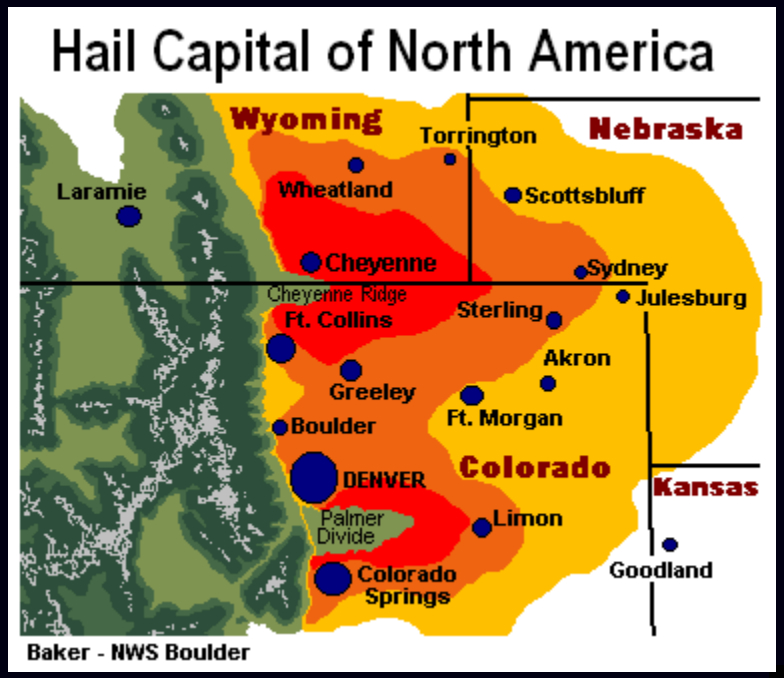
An Increased Likelihood of Damaging T-Storm Winds

Drought and Increased Wildfire Danger Later in the Summer

Many streams and creeks have already begun to run fast and high in Colorado's high country.

In the next few weeks, the anticipated rapid warm up will likely cause the record snow pack melt in the northern and central mountains to melt quickly melt which will cause heavy runoff, and potentially significant flooding on many mountain and high valley rivers and streams.

Hail Season is Upon Us



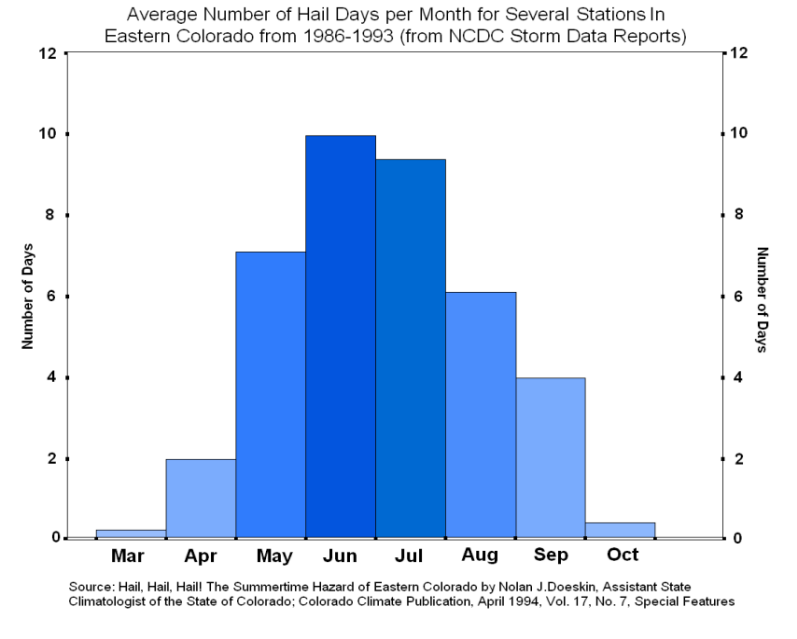
"The lee side of the Rocky Mountains, namely eastern Colorado (and southeast Wyoming), has the nations' greatest hail frequency, the greatest hail intensity with the largest average hailstones, the highest average number of hailstones, and the longest hail storm durations."

Stanley A. Changnon, David Changnon and Steven D. Hilberg, "Hailstorms Across the Nation – An Atlas About Hail and Its Damages", Illinois State Water Survey, Champaign, IL November 2009

The greatest average frequency of hailstorms is the vicinity of Cheyenne, Wyoming along the Cheyenne Ridge.

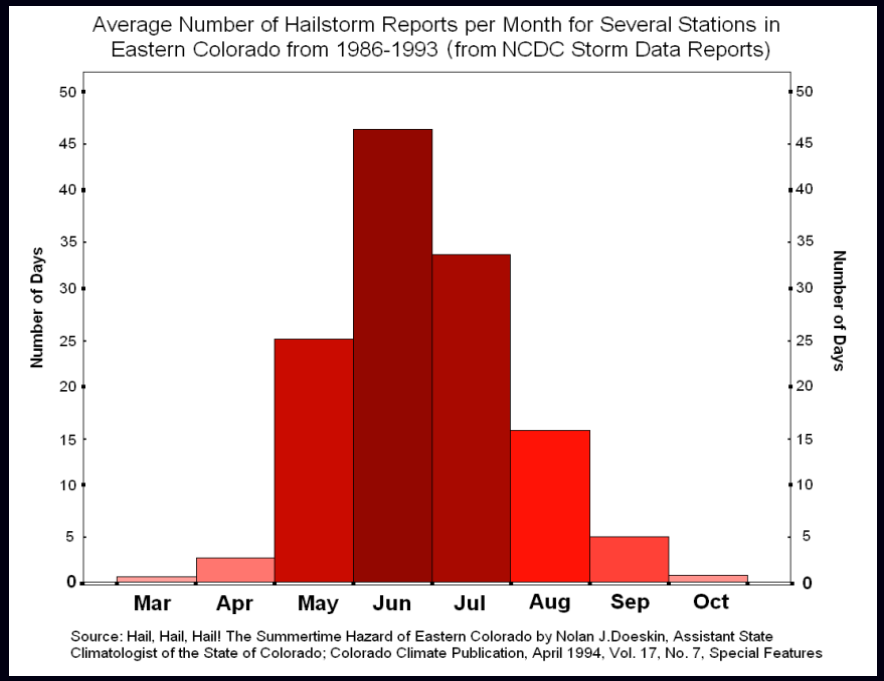
A second area of high frequency exists along the elevated terrain separating Denver and Colorado Springs known as the Palmer Divide.

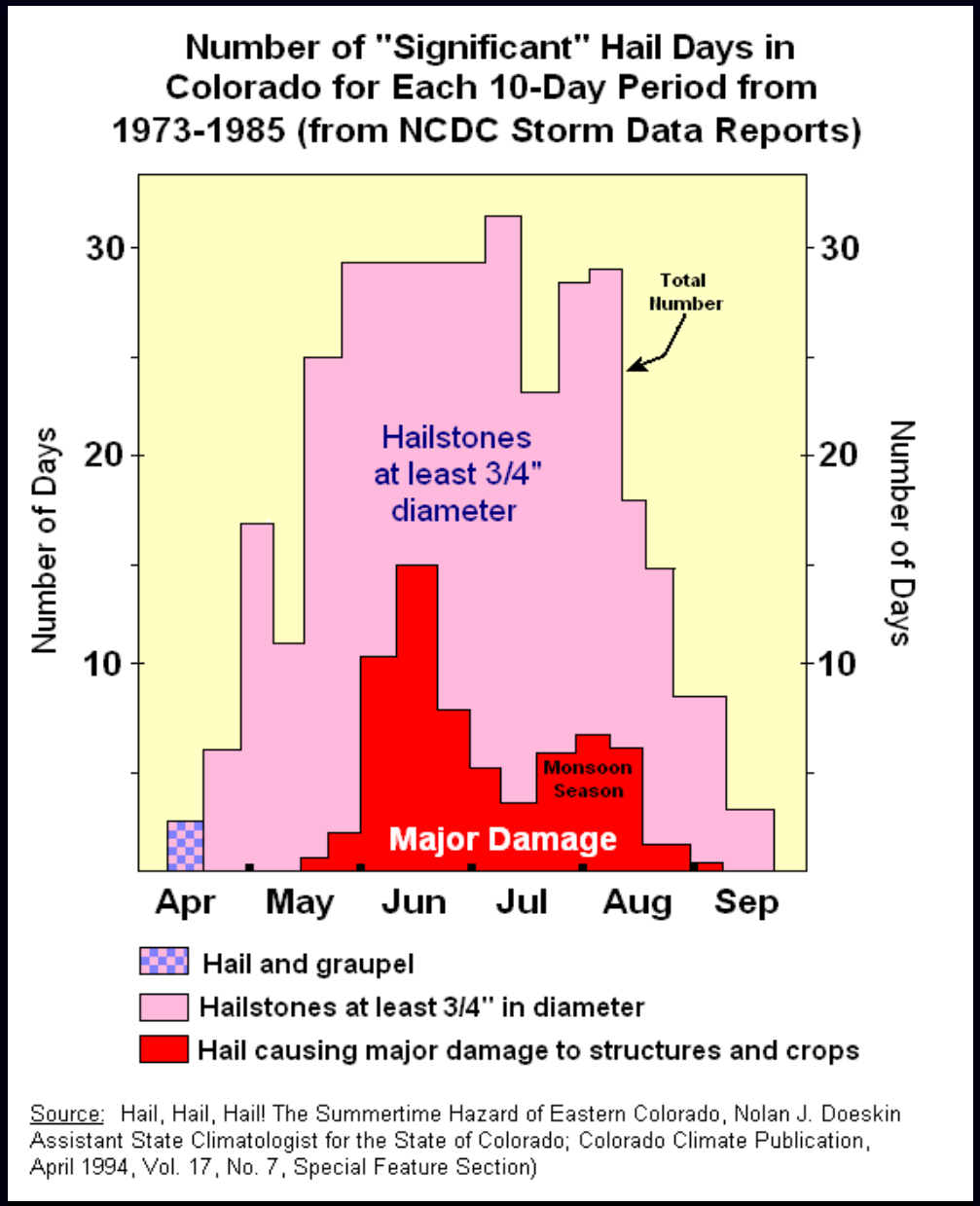
Hail poses a serious danger to life and property, especially when driven by powerful thunderstorm winds.



The hail season in eastern Colorado normally ramps up during the month of May. By June the hail season is typically in full swing. By August, the occurrence of hail begins to drop off as the late summer atmosphere gradually becomes drier, warmer and more stable.

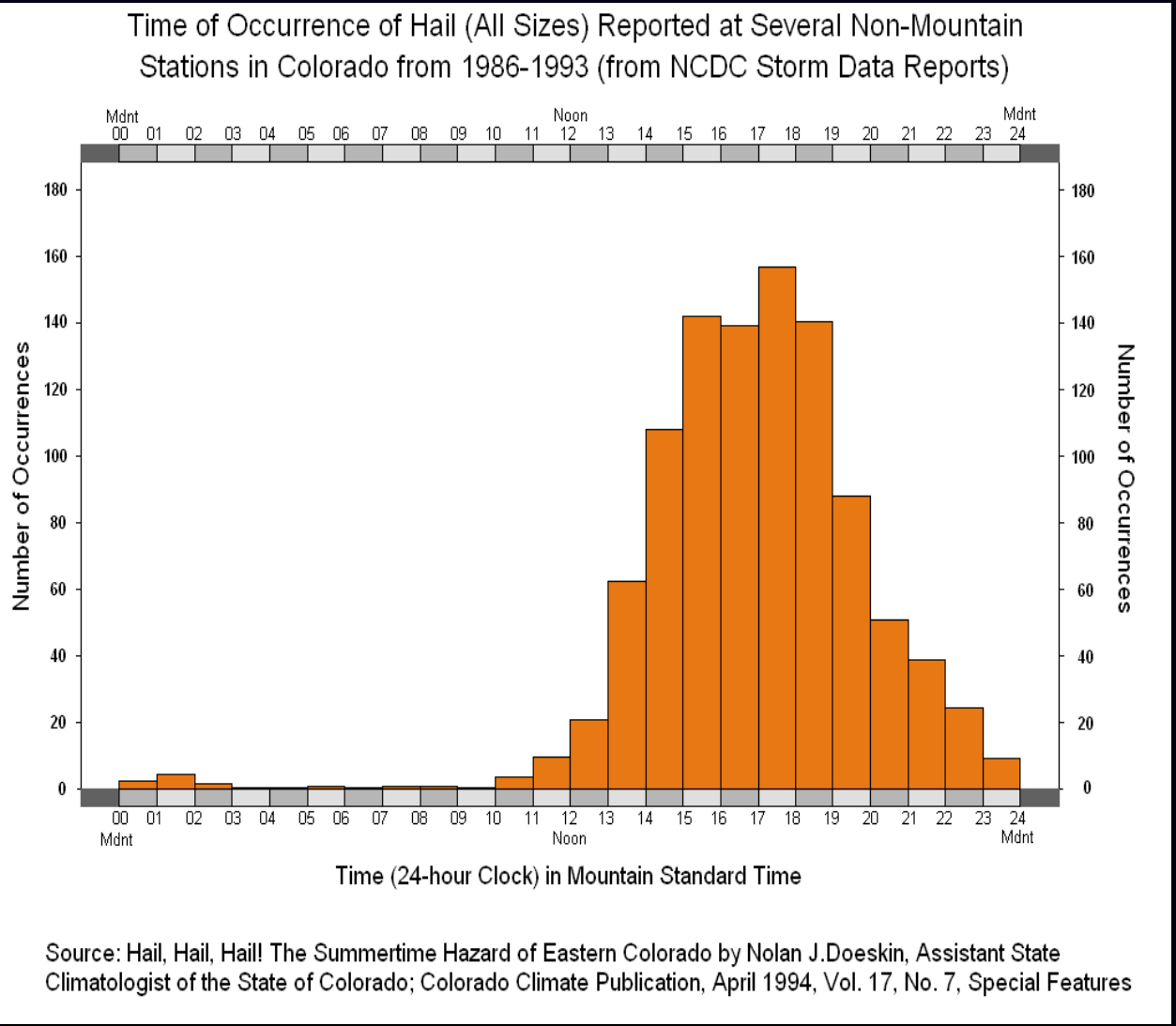
The number of hail days and hailstorm reports per day peaks in June, with July being the second most active month for hail in eastern Colorado.





According to the previous slide, hail occurrence in eastern Colorado normally increases dramatically during May, and peaks during June. Hail from thunderstorms during June and July normally produces the lion's share of major damage to property and crops in eastern Colorado.

A second peak in damaging hail storms occurs in late July and early August with a resurgence of thunderstorm activity during the so-called "summer monsoon season."

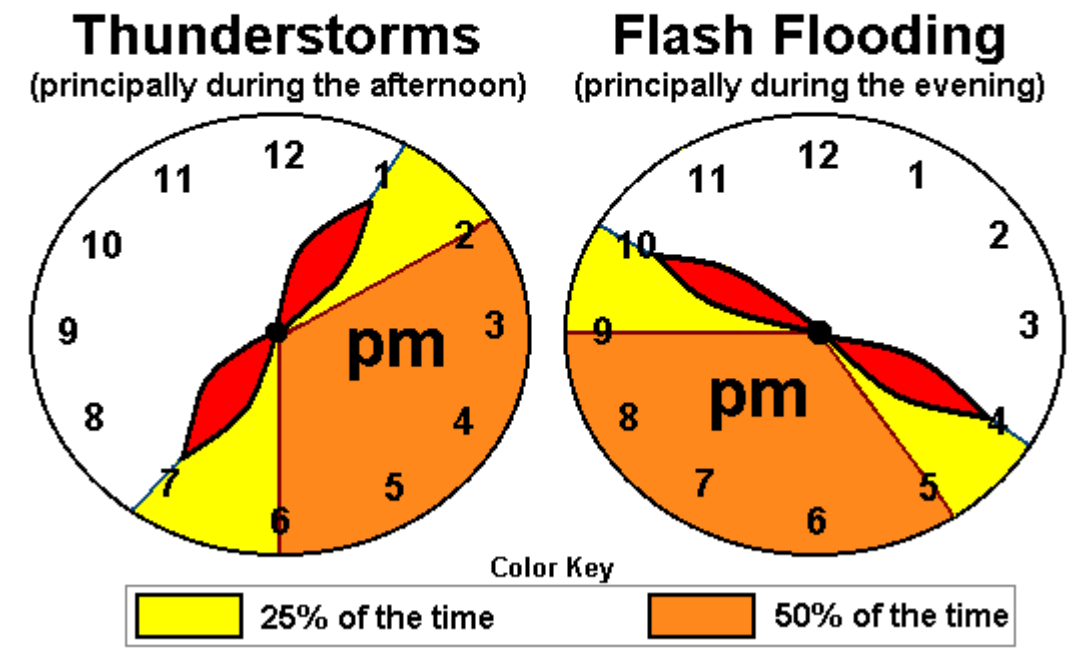


Source: Hail, Hail, Hail! The Summertime Hazard of Eastern Colorado by Nolan J.Doeskin, Assistant State Climatologist of the State of Colorado; Colorado Climate Publication, April 1994, Vol. 17, No. 7, Special Features

The time of occurrence of hail in Colorado closely matches with daily cycle of thunderstorm development during the spring and summer.

In Colorado, thunderstorms are more likely to form as a result of strong daytime heating in an atmosphere with a sufficient amount of humid air, particularly near the ground. Once a critical air temperature is reached, strong updrafts form producing towering clouds that grow into thunderstorms. Most of this convective activity begins around midday, and will then continue through the afternoon during the period of maximum heating. This is also when hail occurrence peaks, normally around 5 to 6 pm.

Average Occurrence of Thunderstorms and Flash Flooding Along the Colorado Front Range from May through August



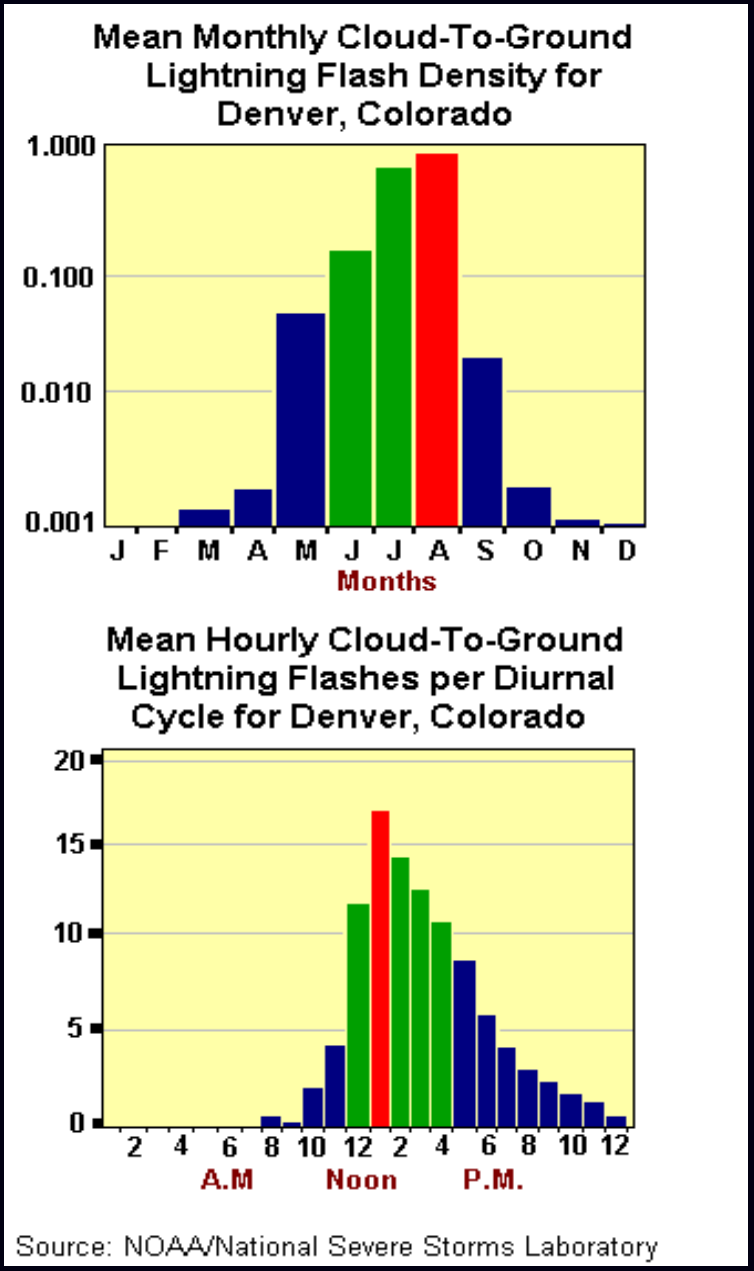
Baker - NWS Boulder

As mentioned in the previous slide, thunderstorms in Colorado during the spring and summer are most likely to form during the afternoon and early evening when temperatures are at their warmest. Thunderstorms in northeast Colorado will usually form first over the heated slopes of the Front Range before drifting out over the adjacent high plains.

Most thunderstorms along the Front Range occur from 2 pm to 6 pm, although thunderstorms can and do occur at anytime of the day or night.

Though less frequent, thunderstorms during the late afternoon and evening hours are often slow movers due to lighter winds aloft at that time of day. These late day storms are often responsible for most of the flash flooding over and along the Front Range, particularly during July and early August.

The Lightning Threat Along the Colorado Front Range

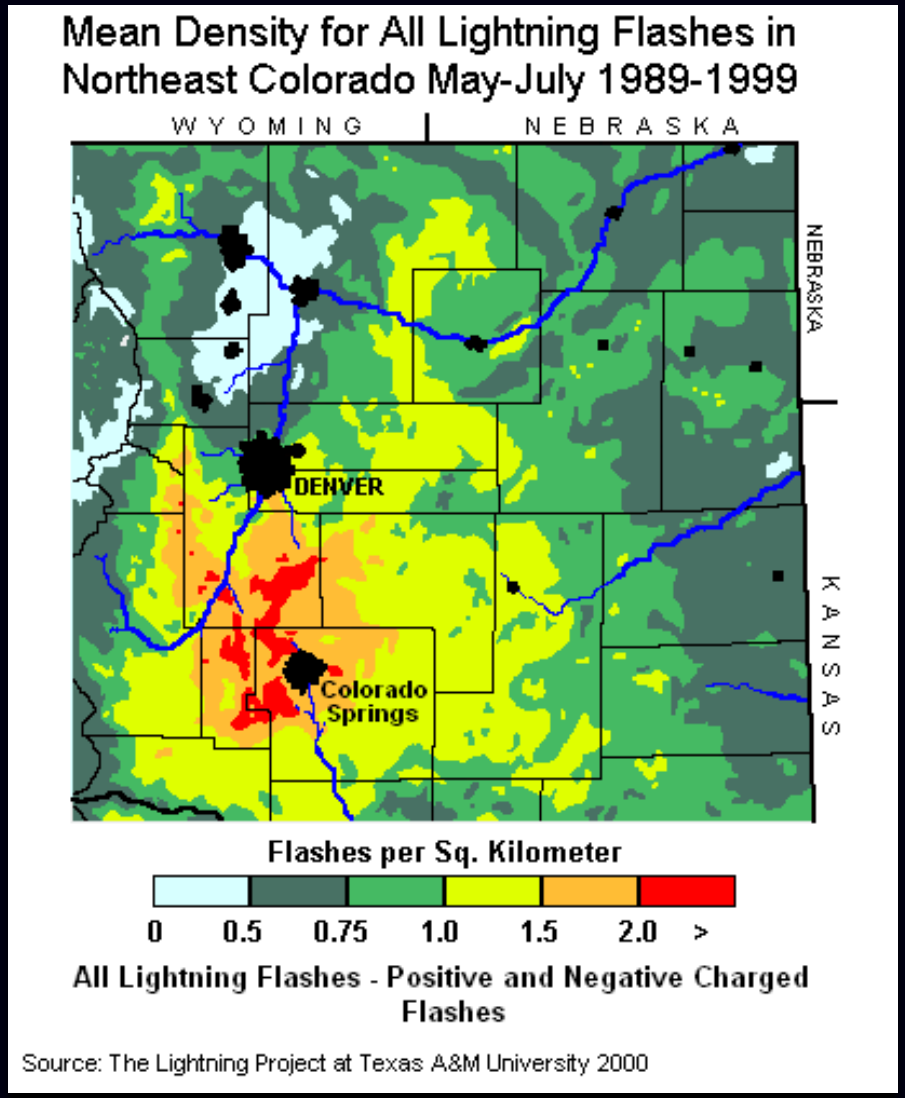


Along the Front Range in northern Colorado, lightning frequency increases steadily during the months of May, June and July, and normally peaks during the month of August.

On average, lightning frequency in the Denver area peaks early in the afternoon with the initial wave of thunderstorms moving off the Front Range. Its frequency will then decrease through the afternoon as thunderstorm activity shifts further out onto plains.

Lightning in the Denver area is also more likely to occur later in the day as we move further into summer. This is because of a strengthening temperature inversion aloft that can delay and even inhibit the formation of a thunderstorm.

One of the Most Active Areas for Lightning in the United States



The Lightning Project conducted by Texas A&M University in 2000 revealed that cloud-to-ground lightning were most likely to occur over the elevated terrain between Denver and Colorado Springs known as the Palmer Divide. The greatest frequency of lightning flashes was detected around Colorado Springs. Coincidently, this is also an area of high hail occurrence.

This study, covering ten years of lightning flashes (both positively and negatively charged strokes), revealed an area of unexpectedly low lightning activity along the northern Front Range around the cities of Longmont, Loveland, Fort Collins and Greeley. No clear explanation was offered for the lack of lightning activity in this area.

Drought, Wildfires and La Niña

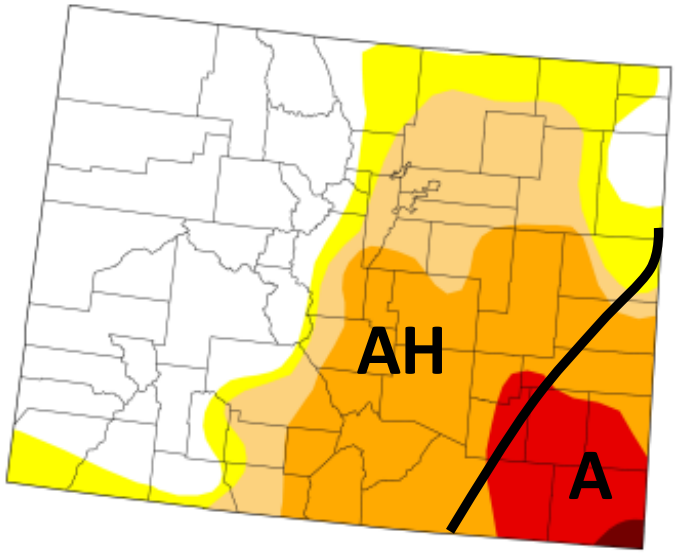
U.S. Drought Monitor

May 17, 2011
Valid 7 a.m. EST

Colorado

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	42.60	57.40	45.12	31.10	7.53	0.34
Last Week (05/10/2011 map)	39.59	60.41	52.58	40.72	3.25	0.00
3 Months Ago (02/15/2011 map)	41.65	58.35	49.57	8.93	0.00	0.00
Start of Calendar Year (12/28/2010 map)	40.40	59.60	49.57	10.13	0.00	0.00
Start of Water Year (09/28/2010 map)	28.86	71.14	10.70	0.00	0.00	0.00
One Year Ago (05/11/2010 map)	82.81	17.19	2.25	0.00	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

A – Agricultural Impact H – Hydrological Impact

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

USDA National Drought Mitigation Center

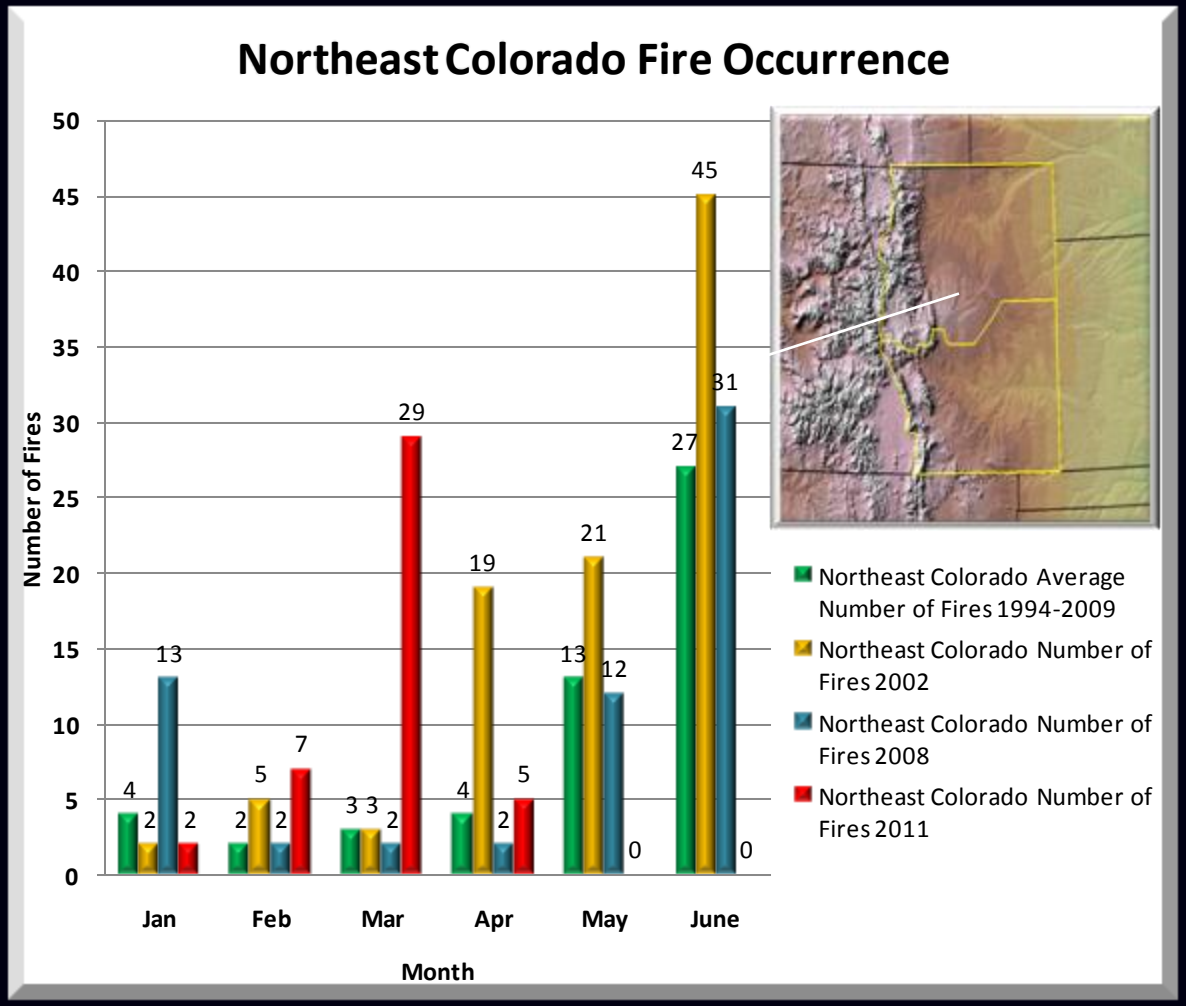
Released Thursday, May 19, 2011
David Miskus, NOAA/NWS/NCEP/CPC

As of May 17, 2011, severe (D2) to extreme (D3) drought conditions prevailed across southeast Colorado, with exceptional drought conditions (D4) in the far southeast corner of the state. The remainder of eastern Colorado had abnormally dry (D0) to moderate drought (D1) conditions. Abnormally dry conditions were also detected along the state's southwest border.

The most severe drought conditions in southeast Colorado are impacting both agricultural (A) and hydrological-water (H) interests.

Rocky Mountain Area

2011 Fire Occurrence

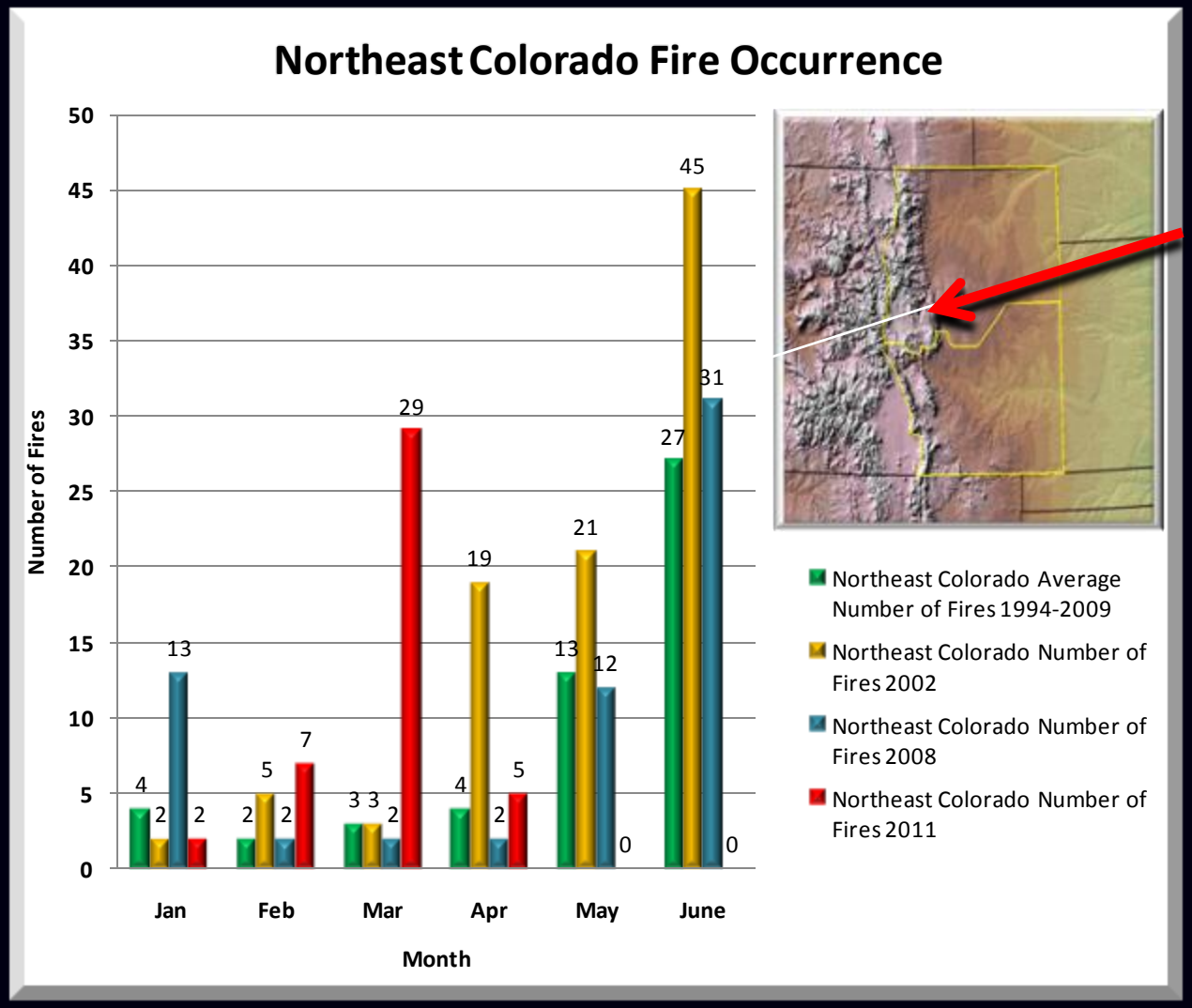


After numerous wildfires in northeast Colorado during March and early April of this year, wildfire starts dropped off appreciably in late April and May due in large part to cooler temperatures, more cloud cover, a dramatic increase in wetting precipitation, less wind and with the normal green up of fuels.

It appeared that the 2011 wildfire season was going to far exceed the pace set during the record breaking wildfire season of 2002. Fortunately that has not happened.

Rocky Mountain Area

2011 Fire Occurrence



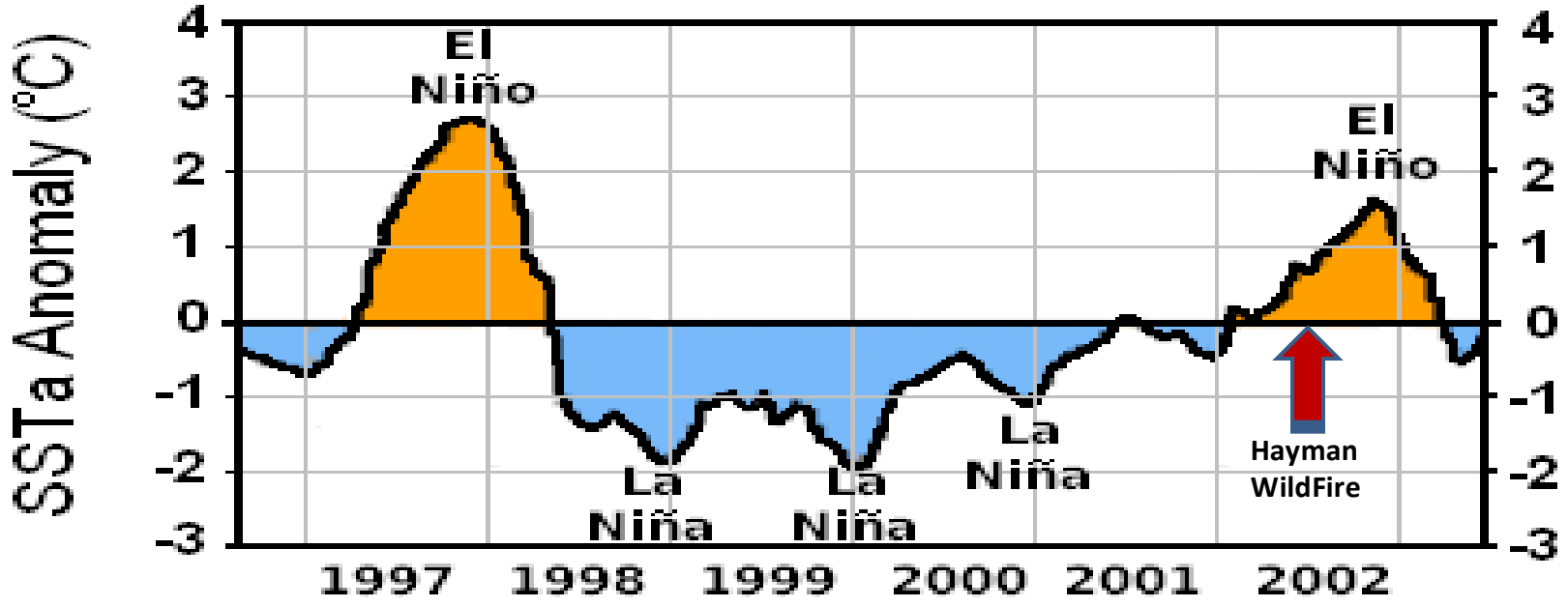
In June and July of 2002, the Hayman wildfire in the foothills southwest of Denver was Colorado's largest wildfire on record.

Note the number of wildfire occurrences across northeast Colorado during June of 2002 (gold bar), compared to the average number of occurrences from 1994 to 2009 (green bar.)

Conditions Leading to the Record Setting 2002 Hayman Wildfire Southwest of Denver

Three years of severe to extreme drought conditions and record breaking heat beginning in 1999 produced some of the driest fuel moisture levels ever recorded in Colorado.

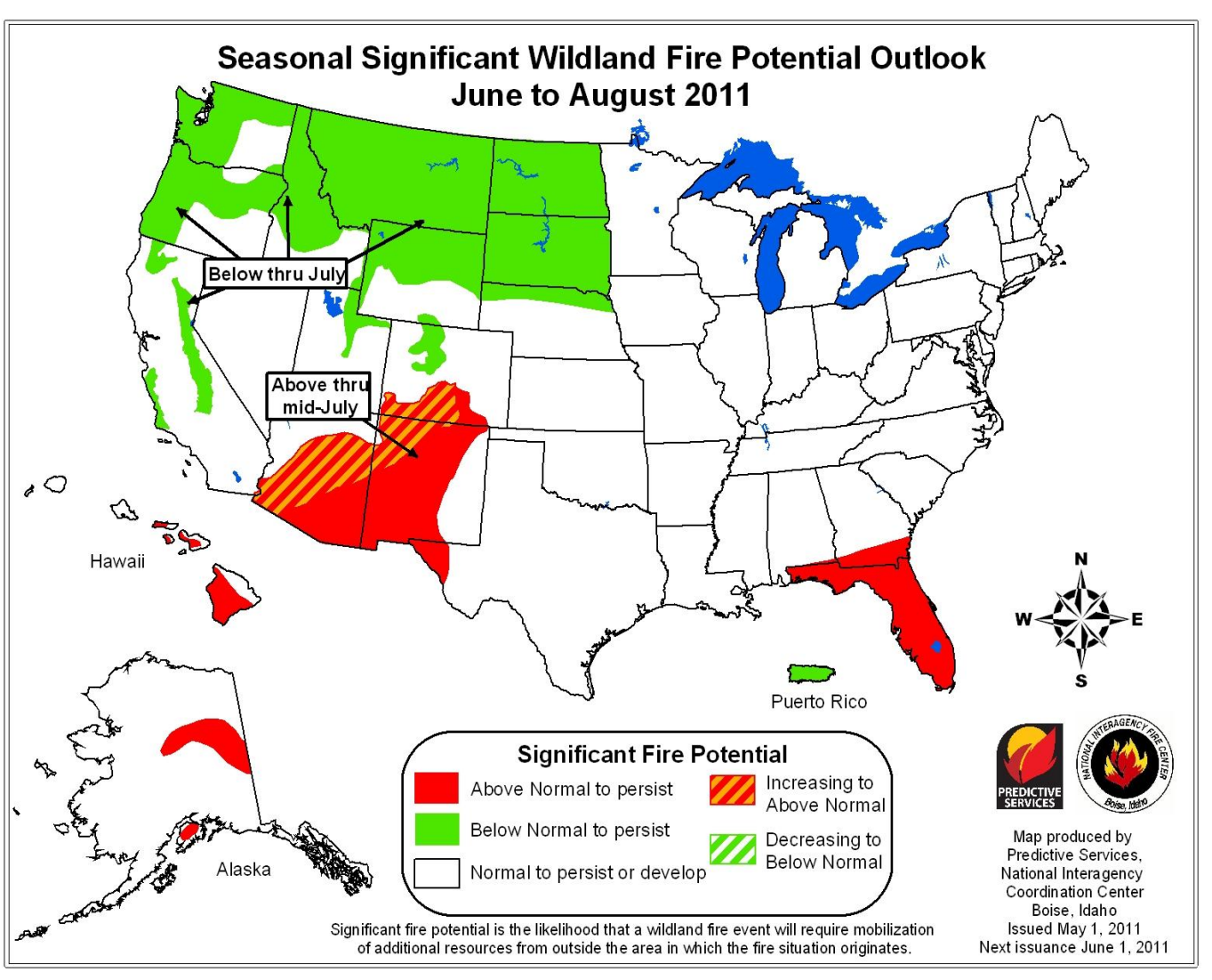
This extended period of drought and record heat coincided with an equally long period of moderate to strong La Niña conditions. The record breaking Hayman wildfire occurred at the end of this unseasonably hot and dry cycle and just prior to the start of a moderate strength El Niño.



Sea Surface Temperature Anomaly (SSTa) plot from October of 1996 to April of 2003 for the NINO 3.4 region of the tropical eastern Pacific Ocean

During Colorado's record breaking 2002 wild fire season, forest acreage and property loss far exceeded losses incurred during the previous devastating wild fire season in 1996.

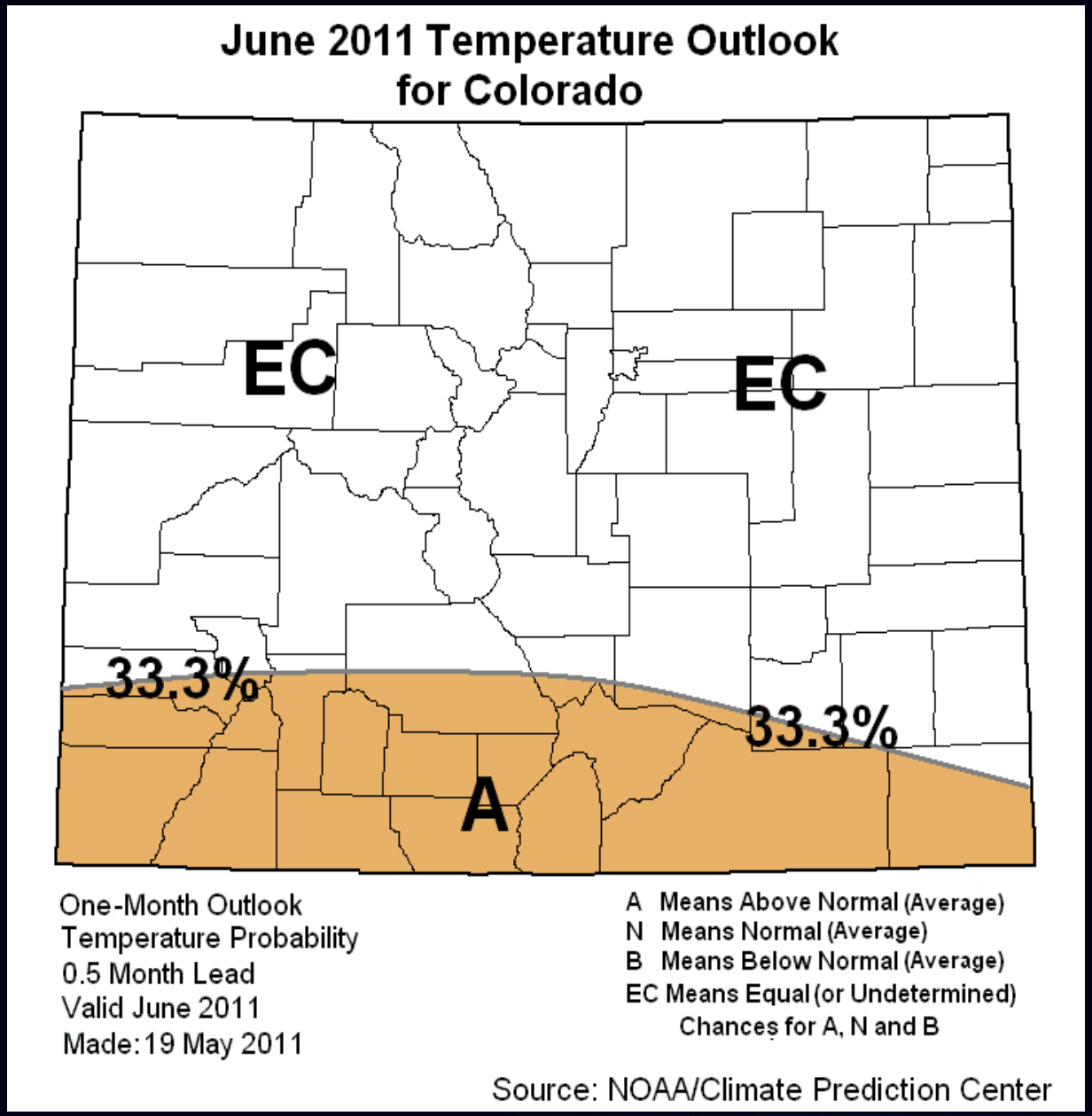
From June 8 to July 18, 2002, losses from the infamous Hayman wildfire southwest of Denver included nearly $40 million in damages, 133 homes burned or destroyed, and over 138,000 acres lost.



The outlook for the upcoming months of June through August places the greatest potential for significant wildfire across south central and southwest Colorado.

The outlook is for above normal temperatures and below normal precipitation in these areas.

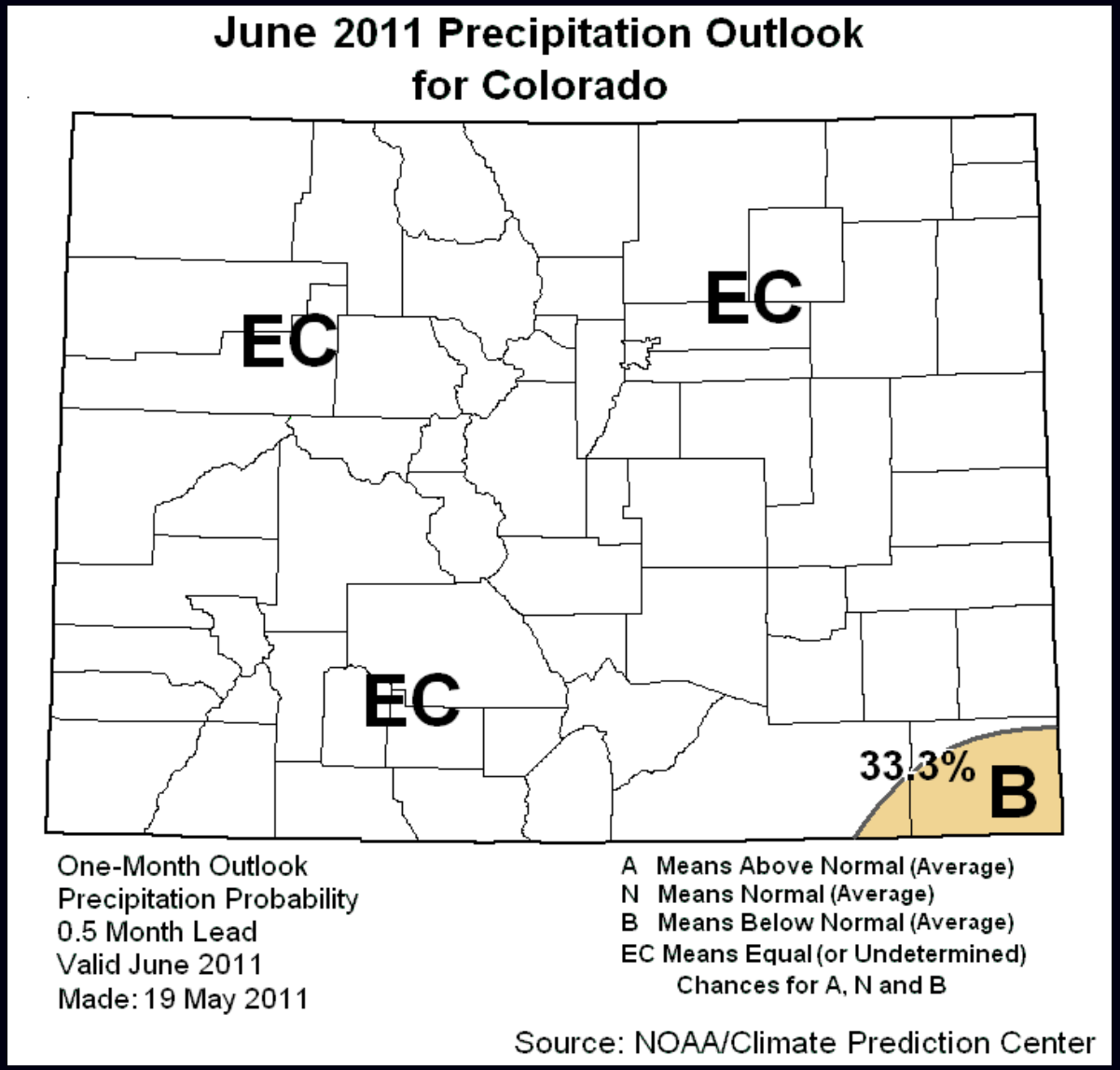
Temperature and Precipitation Outlooks for Colorado For June-July-August 2011 From NOAA's Climate Prediction Center



June 2011 Temperature Outlook For Colorado

The outlook from the Climate Prediction Center (CPC) calls for at least a 33 percent chance of above average temperatures across the southern portion of the state.

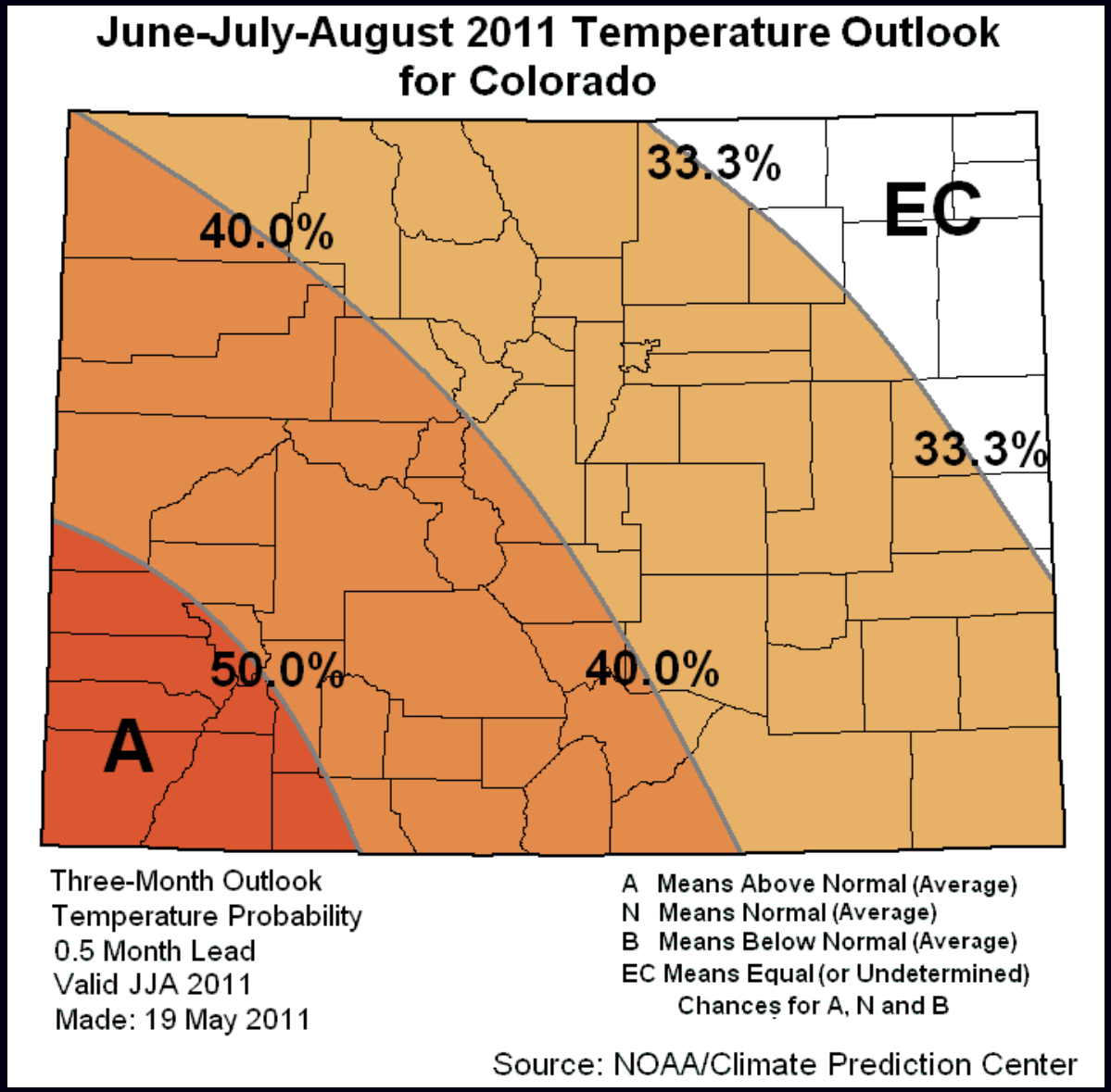
The temperature outlook for the remainder of Colorado is less uncertain as indicated by the EC designation.



June 2011 Precipitation Outlook For Colorado

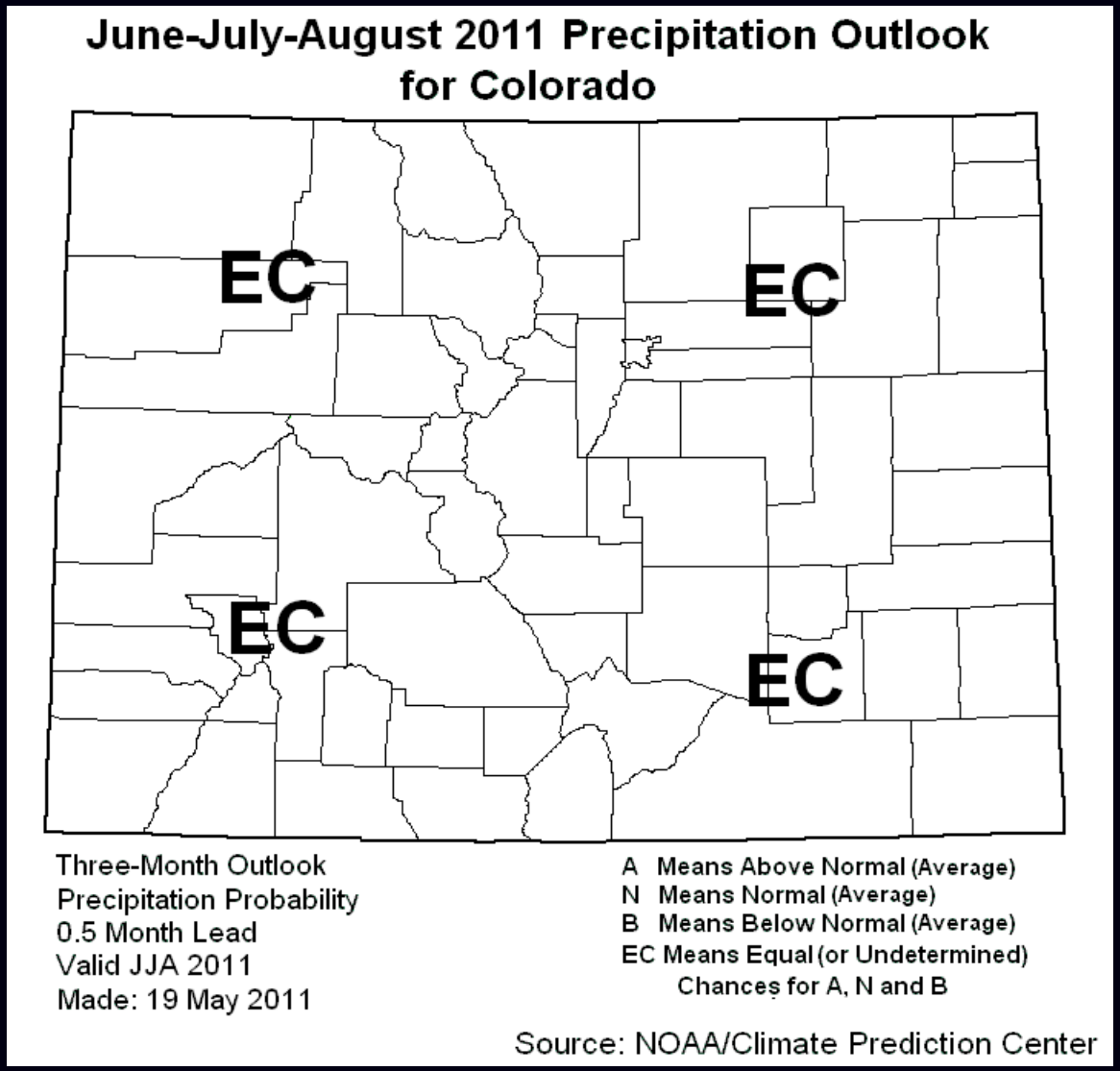
The outlook from the Climate Prediction Center (CPC) calls for at least a 33 percent chance of below average precipitation across the extreme southeast corner of the state.

The precipitation outlook for the remainder of Colorado is less uncertain as indicated by the EC designation.



June, July and August 2011 Temperature Outlook for Colorado

The outlook from CPC calls for at least a 50 percent chance of above average temperature across the southwest corner of Colorado, a 40 to 50 percent chance of above average temperature across the remainder of western Colorado, and a 33.3 to 40 percent of above average temperature over the northern mountains, along the Front Range and the southeast plains. The outlook for the northeast corner of the state is less uncertain as designated by the EC symbol.



June, July and August 2011 Precipitation Outlook for Colorado

The outlook from CPC calls for an equal or undeterminable chance of above, below and near average precipitation across Colorado, as indicated by the symbol EC.